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A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 21

AUGUST 1972

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 21

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in July 1972 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*



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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 362 reports, journal articles, and other documents originally announced in July 1972 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

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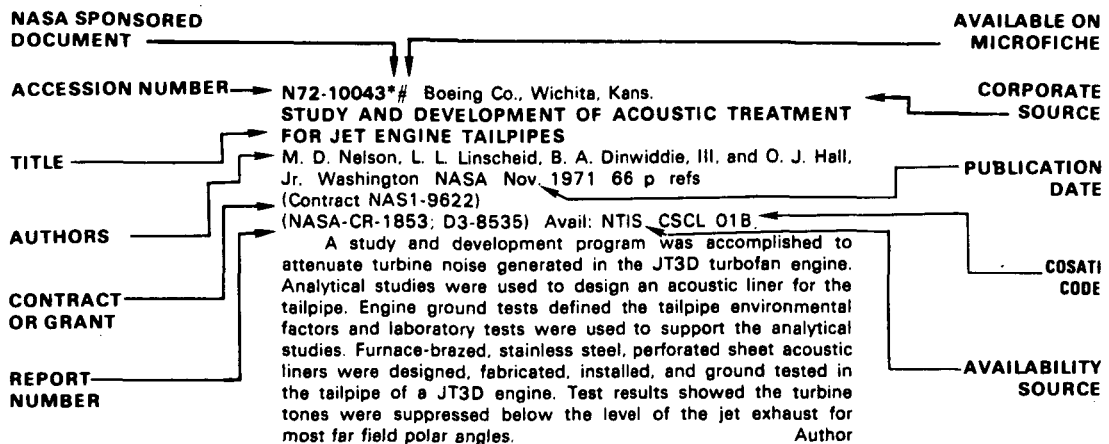
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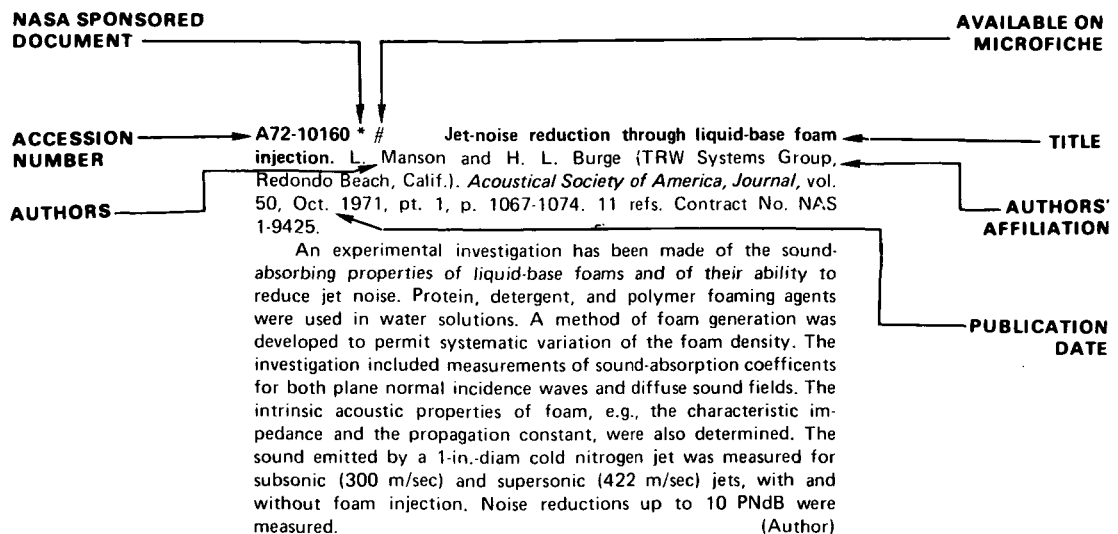
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TYPICAL CITATION AND ABSTRACT FROM IAA





AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 21)

AUGUST 1972

IAA ENTRIES

A72-28353 Reliability requirements and optimization for complex systems. K. Niemeyer (Industrieanlagen-Betriebsges. mbH, Ottobrunn, West Germany). In: Operations research and reliability; Proceedings of the Conference, Turin, Italy, June 30-July 4, 1969. New York, Gordon and Breach, Science Publishers, Inc., 1971, p. 47-60; Discussion, p. 60, 61.

It is shown that the specification of system reliability requires a tradeoff between reliability and all other parameters that affect system effectiveness. This tradeoff is illustrated by the example of an aircraft weapon system where reliability is investigated versus factors such as mission survivability, environmental and human factors, and system performance. A method to determine adequate efforts to improve component reliability of an aircraft weapon system is discussed. O.H.

A72-28355 A method of determining the cost effectiveness of different levels of reliability and maintainability for a training aircraft. J. K. R. Wood (RAF, London, England). In: Operations research and reliability; Proceedings of the Conference, Turin, Italy, June 30-July 4, 1969. New York, Gordon and Breach, Science Publishers, Inc., 1971, p. 145-169; Discussion, p. 169, 170.

A study has been conducted with the aim to determine, by using a computer simulation, the effect of different levels of reliability and maintainability of an aircraft type on the flying output of a flying training unit. The method that has been employed is the use of a simple algebraic model to support, in a limited way, the main investigation using computer simulations. Certain features of aircraft operations, such as the number of aircraft undergoing scheduled servicing, can be estimated with fair accuracy from this simple model with comparatively little effort. On the other hand, the effect of changes of resources, such as servicing manpower on the aircraft time awaiting manpower, are best obtained from the full computer simulation. O.H.

A72-28358 Reliability of aircraft as determined by operational field tests - The need for proper test design and data requirements. C. F. Bell (RAND Corp., Santa Monica, Calif.). In: Operations research and reliability; Proceedings of the Conference, Turin, Italy, June 30-July 4, 1969. New York, Gordon and Breach, Science Publishers, Inc., 1971, p. 233-249.

The reliability and maintainability of complete aircraft systems, such as tactical fighter squadrons and airline transportation systems, is considered. It is shown that the probable causes of the extra-

ordinary variances in reported reliabilities of apparently similar or identical equipments in aircraft systems can be grouped into three categories: reliability characteristics of the equipments and the operating and environmental stresses to which they are subjected; the complexities and interactions of aircraft systems; and faulty data inferences caused by erroneous information. The possibility of improved operational testing of the complete aircraft system in order to validate the reliability specifications of its individual equipments is discussed in detail. O.H.

A72-28359 Possibilities of checking the reliability assumptions made during the design of a weapon system using the results of flight tests. S. Vogt (Industrieanlagen-Betriebsges. mbH, Ottobrunn, West Germany). In: Operations research and reliability; Proceedings of the Conference, Turin, Italy, June 30-July 4, 1969. New York, Gordon and Breach, Science Publishers, Inc., 1971, p. 251-267; Discussion, p. 267, 268.

During the design phase of a weapon system, the reliability assessment is based on assumptions which result from experience in operational systems. This paper attempts to show how it is possible to check these assumptions by the results of prototype system tests. Because of the limited number of test flights, one investigates to what level (for example, system, subsystem, group of parts or separate part) and by what methods a useful demonstration and test of reliability assumptions can be realized. (Author)

A72-28360 Reliability prediction in cost effectiveness analyses. R. Chaplin (Royal Aircraft Establishment, Farnborough, Hants., England). In: Operations research and reliability; Proceedings of the Conference, Turin, Italy, June 30-July 4, 1969. New York, Gordon and Breach, Science Publishers, Inc., 1971, p. 269-286; Discussion, p. 286-288.

An examination of the reliability histories of aircraft and avionics has been carried out in an attempt to identify and isolate any factors relating to either the use or the design of the system which were statistically significant. As a result, several critical factors have emerged: aircraft size and performance; equipment complexity and technological data; sortie duration; flying rate; aircraft protection; and length of production run. The effects of these and other parameters are discussed in relation to the assessment of the reliability of a hypothetical strike aircraft. O.H.

A72-28363 Statistical debugging (Détermination statistique). M. Da Silveira (Société d'Etudes et Conseils, Paris, France). In: Operations research and reliability; Proceedings of the Conference, Turin, Italy, June 30-July 4, 1969. New York, Gordon and Breach, Science Publishers, Inc., 1971, p. 357-365; Discussion, p. 364, 366. In French.

Some qualitative results are presented concerning three parametric approaches to the statistical burn-in or debugging problems: when to stop the burn-in or the debugging period. As a rule, times for full burn-in are shown to be prohibitive. An alternative approach was sought, that of a partial component burn-in, leading to a reduced equipment debugging time. O.H.

A72-28400 # A mission effectiveness model using weather state information. H. Gottschalk (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *Operations Research Society of America, National Meeting, 41st, New Orleans, La., Apr. 26-28, 1972, Paper, 19 p.*

A tactical air operation simulation model is described wherein decision and operation functions are influenced by weather information. The problem concerns the selection of aircraft from a mixed fleet of all weather and visual condition aircraft and the selection of primary and secondary targets from a set where weather observations are available at varying intervals. Mission success is achieved if the aircraft encounters proper weather conditions over target. Results show greater mission effectiveness as the frequency of weather state observations is increased. At present cloud cover is the only weather parameter of interest. (Author)

A72-28451 # RMVs in aerial warfare. W. B. Graham (RAND Corp., Santa Monica, Calif.). *Astronautics and Aeronautics*, vol. 10, May 1972, p. 36-47. 22 refs.

Factors forcing the interest in possible military uses of Remotely Manned Vehicles (RMVs) include the increasing lethality of anti-aircraft defenses, the present level of vehicle and equipment costs, and the technological advances of the past ten years. The role of man during a combat mission is examined. It is found that man's presence is only needed when he, in effect, has to 'see' something - discriminate and decide. Now the technical means are available to displace these three functions too by communications and remote control. The great advantage of a RMV as a bomber is based on its ability to get close to the target before releasing free-fall ordnance. In general, the RMV weapon will find profitable application whenever air defenses can be expected to exact high loss rates. G.R.

A72-28452 # Air cargo confidence. C. R. Frieze (Boeing Co., Seattle, Wash.). *Astronautics and Aeronautics*, vol. 10, May 1972, p. 48-54.

The growth potential in the air-cargo field is discussed, giving attention to market status, marketing techniques, and the potential impact of progress in technology. Factors of minimum long-term growth are examined. It is pointed out that the bulk of new lift requirements must be satisfied by large freighter aircraft if air cargo is to achieve reasonable profits. The international routes require the greatest lift addition. The need for a reexamination of the market and the possible changing of routes to fit the geography of specific commodity-production centers is considered. G.R.

A72-28541 Numerical analysis of electromagnetic radiation properties of smooth conducting bodies of arbitrary shape. D. L. Knepp (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.) and J. Goldhirsh (Tel Aviv University, Holon, Israel). *IEEE Transactions on Antennas and Propagation*, vol. AP-20, May 1972, p. 383-388. 7 refs. NSF Grant No. IG-705; Contract No. DA-28-043-AMC-02411(E).

A numerical-theoretical technique is described for determining the surface current density distribution and subsequently the near- and far-zone fields of an arbitrarily shaped perfectly conducting body excited by an arbitrary primary source. The arbitrary surface is described by dividing it into a number of connected cells which are

mathematically described as quadric surfaces. The 'arbitrary body' formulation is applied to two configurations; namely the radial dipole above a conducting cylinder of finite length and a quarter-wavelength monopole mounted atop the fuselage of a CH-47 helicopter. The numerical results are compared with those obtained through an experimental program as well as those obtained by alternate numerical means and good agreement is noted. (Author)

A72-28555 # Uses of composite materials in aircraft structures (Primenenie kompozitsionnykh materialov v aviatsionnykh konstruktsiakh). A. S. Vol'mir, V. F. Pavlenko, and A. T. Ponomarev (Voenno-Vozdushnaia Inzhenernaia Akademiia, Moscow, USSR). *Mekhanika Polimerov*, Jan.-Feb. 1972, p. 105-112. 14 refs. In Russian.

The applicability of a group of composite boron and carbon plastic fiber materials in aircraft structural component and engine designs is evaluated as an approach to the damping of aircraft reactions to dynamic and impact forces. The properties of some well-developed composites are compared with those of conventional materials. Examples are given for some aircraft applications of composites. V.Z.

A72-28575 Fighter keyed to transonic speed range. E. J. Bulban. *Aviation Week and Space Technology*, vol. 96, May 1, 1972, p. 37, 38.

A combination of the lightest possible airframe with advanced aerodynamic and flight control technologies is emphasized in the General Dynamics Model 401 air-superiority fighter. Key design features of the new fighter include a single-engine configuration, a fly-by-wire control system, an inclined seat for the pilot to improve his g-force tolerance, and forebody strakes to the wing leading edges. Major attention was given to factors relating to maneuverability at high speeds and high angles of attack. G.R.

A72-28693 # Problems of aircraft electrical power systems. R. K. Abrol (Institution of Engineers /India/, Calcutta, India). (Institution of Engineers /India/, Semi-Annual Meeting, Calcutta, India, Aug. 13-15, 1971.) *Institution of Engineers (India), Journal, Mechanical Engineering Division*, vol. 52, Sept. 1971, p. 1-8. 8 refs.

The most important factors which give rise to special requirements in the case of the aircraft electrical power system are examined. They include: effect of latitude; requirement of minimum weight; high degree of reliability and safety; wide variations in climatic and environmental conditions; vibration and noise; rapid acceleration and deceleration; integration with engine design; and ease of inspection and maintenance. The effects of these factors on the design of aircraft electrical system are investigated. Wherever possible, suggestions are given as to the manner in which their adverse effect can be minimized. O.H.

A72-28698 # The design and application of secondary surveillance radar systems. R. Shipley (Cossor Electronics, Ltd., Harlow, Essex, England). (Institution of Engineers /India/, Symposium on Radar Techniques and Systems, New Delhi, India, May 1-3, 1970.) *Institution of Engineers (India), Journal, Electronics and Telecommunication Engineering Division*, vol. 52, Sept. 1971, p. 28-30.

Outline of the basic advantages of the system, among which are greater range for less transmitted power, no weather or ground clutter, positive identification without aircraft maneuvering, and indication of flight level or altitude. However, until all aircraft in the system carry transponders, both primary and secondary radars should be used in conjunction. Operational requirements, equipment specification, and system configuration are discussed. The importance of careful planning for optimum SSR utilization is emphasized. F.R.L.

A72-28701 # SR-71 ejection experience. R. H. Shannon and A. N. Till, Jr. (USAF, Directorate of Aerospace Safety, Washington, D.C.). *SAFE Engineering*, vol. 1, 4th Quarter, 1971, p. 3-6.

Description of the Lockheed ADP SR-1 stabilized ejection seat, and review of case histories of six ejections from four accidents. The SR-1 seat is activated by a seat-mounted D-ring. It includes a high-impulse rocket catapult that produces an impulse of approximately 2000 lb-sec and a separation velocity of 49 ft/sec. The average peak acceleration of the catapult at 70 F is of the order of 15 Gs, with a rate of onset of about 170 G per sec. It uses a ballistically deployed drogue chute that provides rapid, controlled deceleration and stability, and aids in seat-man separation. The system is designed to provide safe recovery of the crew from a static condition on the runway (zero-zero) to Mach 3 plus at extremely high altitudes. It has been successfully used through the total range of system capability. The advantages of the SR-1 seat over other open seat systems are discussed. M.V.E.

A72-28726 # Crashworthy personnel restraint systems for general aviation. R. A. Hughes (Pacific Scientific Co., Anaheim, Calif.). *SAFE Engineering*, vol. 2, 1st Quarter, 1972, p. 2-7, 20. 5 refs.

Basic types of active restraint systems are examined. Currently available strap take-up devices can be classified as inertia sensing or noninertia sensing. It is deduced that the poor acceptance of the currently available fixed shoulder harness in automotive systems stems from the failure to meet certain qualitative specifications relating to comfort, fit, ease of use, freedom to move, and the consequent lack of user confidence. One result has been increased demand for passive restraint systems which require no action on the part of the vehicle occupant. It is pointed out that effective cooperation between the restraint system designers and aircraft installation engineers will insure that the aircraft equipped with these systems will also meet the qualitative requirement of comfort, proper fit, and the ease of donning and removing. G.R.

A72-28728 # Reaction thrust of a semibounded turbulent jet in boundary-layer blowing systems and blow-type anti-icing systems (K voprosu o reaktivnoi tiage poluogranichennoi turbulentnoi strui v sistemakh sduva pogrannichnogo sloia i struinnoi protivoledenitel'noi zashchity). V. S. Maksimov and A. V. Zelen'ko. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 24, 1971, p. 3-8. 9 refs. In Russian.

It is shown that in anti-icing systems employing boundary layer control by slit blowing, the drop in thrust-weight ratio of the aircraft due to air bleeding can be compensated for by the reaction thrust at the nozzle exit section. A procedure for calculating the reaction thrust for such systems is proposed. V.P.

A72-28729 # Aerodynamics of a nonflat small-aspect-ratio wing in an inviscid fluid flow (Aerodinamika neploskogo kryla malogo udlineniia v potoke neviaskoi zhidkosti). V. I. Kholiavko. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 24, 1971, p. 8-13. In Russian.

The inviscid incompressible flow past a longitudinally curved (cylindrical twist) small-aspect-ratio slender wing is analyzed within the framework of slender body theory. The influence of the wing planform and curvature of the middle surface of the wing on the aerodynamic characteristics is examined. The superior drag and L/D ratio characteristics of a curved wing as compared to a flat wing are demonstrated. V.P.

A72-28732 # Cavitation failure of the elements of the NP-25-5 hydraulic plunger pump (Kavitatsionnoe razrushenie detalei gidravlicheskogo plunzhernogo nasosa NP-25-5). Zh. S. Chernenko

and V. V. Kisiakov. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 24, 1971, p. 27-34. 8 refs. In Russian.

The cavitation failures arising in the operation of an aircraft plunger pump are studied experimentally, using various working fluids and aircraft fuels. The results of microscopic and metallographic analysis indicate that the fluid does not separate from the piston during operation. The pattern of the principal cavitation pits on the valve and cylinder block shows that the principal sources of the cavitation cloud are the nine holes in the cylinder block. V.P.

A72-28739 # Method of calculating the discriminant of a segment of conical cross section on a digital computer (Metod rascheta diskriminanta uchastka konicheskogo secheniia s pomoshch'iu ETsVM). S. M. Zamalin. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 24, 1971, p. 68-71. In Russian.

The problem of determining the discriminant of a segment of a curve of second order in the solution of geometrical problems associated with the lofting of an aircraft is examined. A computer method of calculating the discriminant by successive approximations is proposed. The accuracy of the method is assessed. The maximum absolute error in the determination of the discriminant is 0.0033. V.P.

A72-28741 # Automation of the calculation of a low-run multiple-nomenclature production process (K voprosu ob avtomatizatsii raschetov proizvodstvennogo protsessa melkoseriinnogo mnogonomenklaturnogo proizvodstva). A. L. Bashta and A. I. Babushkin. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 24, 1971, p. 74-82. In Russian.

Analytical relations for determining the optimal parameters of multiple-nomenclature conveyor-belt production are derived. The respective algorithm is developed with a view toward requirements characteristic of the aircraft industry. A computer program is constructed on the basis of the algorithm. V.P.

A72-28742 # Determination of the point of intersection of a straight line and a second-order curve without plotting the curve (O postroenii tochk pere-secheniia priamoi s krivoi vtorogo poriadka bez vycherchivaniia krivoi). M. A. Zaidenvarg. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 24, 1971, p. 82-84. In Russian.

A nonlinear algebraic transformation proposed by Zaidenvarg (1967) is applied to the development of a simplified approach to the solution of a class of specific problems encountered in the lofting of an aircraft. The procedure proposed is described by relations which can be easily adapted to a computer. V.P.

A72-28757 Simulator refines fighter design. R. R. Ropelewski. *Aviation Week and Space Technology*, vol. 96, May 8, 1972, p. 40, 41, 44, 45.

Description of a large-amplitude flight simulator which can complete such developmental tasks as refinement of stick forces, identification of pilot-induced oscillations, interfacing of equipment, and other qualitative functions that are normally accomplished during flight testing. The simulator is considered to be of great value because it puts the pilot in the loop to help uncover the need for any design refinements long before any hardware is actually produced. The simulator requires an extensive computer commitment. F.R.L.

A72-28758 USAF studies Navsat proposal. B. Miller. *Aviation Week and Space Technology*, vol. 96, May 8, 1972, p. 50, 51 (3 ff.).

Discussion of a proposed demonstration satellite system intended to be an intermediate step toward enabling military aircraft, ships, and ground users to get precise position and velocity

information at any time of day throughout the world and during all weather conditions. The concept would permit suitably equipped users to calculate three-axis coordinate position data, a velocity vector, and a timing signal from continuous transmissions broadcast from four satellites.
F.R.L.

A72-28782 # Computer calculation of the twist of long blades in axial-flow turbines and compressors (Raschet zakrutki dlinnykh lopatok osevykh turbin i kompressorov na ETsVM). Ia. A. Sirotkin. *Energomashinostroenie*, vol. 18, Jan. 1972, p. 4-7. 12 refs. In Russian.

Description of a general procedure for calculating the flow twist in axial clearances between blade rows of axial-flow turbines and compressors. The slope and curvature of meridional streamlines are taken into account, together with radial nonuniformity of flow and drag parameters at the stage inlet. Computer programs were written in the ALGOL-60 language.
T.M.

A72-28785 # New possibilities of short-range radio navigation systems (Novye vozmozhnosti RSBN). V. Zakharov. *Aviatsiia i Kosmonavtika*, Mar. 1972, p. 20, 21. In Russian.

Discussion of new methods for using onboard computers to calculate aircraft position and trajectory parameters relative to ground-based radio beacons. Coordinate plotting procedures are outlined for flight maneuvers ensuring fast and accurate recovery of a prescribed flight path.
T.M.

A72-28786 # The engine and dust erosion (Dvigatel' i pylevaia eroziia). A. Shtoda and A. Nazarov. *Aviatsiia i Kosmonavtika*, Mar. 1972, p. 24, 25. In Russian.

The composition and content of dust in the air ingested by helicopter gas-turbine engines are identified for various flight conditions, and typical forms of erosive damage to flow surfaces of engine components are explained. Pressure losses produced by inlet filtering systems are characterized, and principles of operation are described for inertial rotorless filtering systems providing the best reliability in use with helicopter engines.
T.M.

A72-28792 # Offshore jetport for New York-New Jersey megalopolis. E. G. Nawy (Rutgers University, New Brunswick, N.J.) and F. C. Koletty (USAF, Mount Hebo Air Force Station, Ore.). *ASCE, Transportation Engineering Journal*, vol. 98, May 1972, p. 243-262. 12 refs.

Review of the results of an investigation showing that within the existing political and planning framework an offshore airport for the New York-New Jersey megalopolis is feasible, and indeed, might be the only acceptable solution to this area's need for a fourth airport. An airport is often quite objectionable, especially from the standpoint of noise. Other environmental factors, such as air and water pollution, must be considered. Land conservation is particularly important. It is with these considerations in mind that the offshore international jetport off Long Branch in New Jersey is being proposed. The cost of such a facility would be approximately twice the cost of a land terminal to serve the same need. But the offshore airport would have minimum adverse effects on the land and population of the region.
M.V.E.

A72-28793 # Development of the air cushion aircraft. L. H. Hildebrandt and K. H. Digges (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). (*Canadian Symposium on Air Cushion Technology*, 5th, Ottawa, Canada, Aug. 31, 1971.) *Canadian Aeronautics and Space Journal*, vol. 18, Apr. 1972, p. 91, 92.

Discussion of the Air Cushion Landing System (ACLS) which consists of all components required to maintain an air cushion beneath the aircraft during ground operations and to duplicate the functions of a conventional landing gear. Flexible trunks duct air from an onboard compressor to the fuselage periphery and exhaust it to form a jet curtain. The trunks retract during flight to reduce drag. The braking system consists of expandable 'pillows' located along the bottom surface of the trunk. It is considered that the capabilities of the system would be particularly beneficial to air transportation in the Arctic.
F.R.L.

A72-28795 The European Airbus (L'Airbus Européen). P. Gianni. *Revue Générale de l'Air et de l'Espace*, vol. 34, no. 4, 1971, p. 401-443. In French.

Study of the terms and functioning of the European Airbus program with reference to the tentative procedures for European cooperation, and certain new solutions. The program counts on 600 firm orders throughout the world. It demonstrates the practicability of forming an international organization which is acceptable to governments and to industry, thus making possible design and production programs exceeding the capacity of any single national industry in Europe. The text of the Franco-German agreement is presented.
F.R.L.

A72-28801 International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Conference sponsored by the American Meteorological Society. Boston, American Meteorological Society, 1972. 437 p. In English and French. Members, \$15.; nonmembers, \$20.

Meteorological support of aerospace operations is discussed together with studies of communication systems, missiles, space shuttles, orbiting laboratories, and in situ measurements. Subjects examined include remote soundings, atmospheric structure and circulation, trends in air quality related to worldwide aircraft operations, terminal weather, sensor equivalent visibility, severe convective storms, hail, icing, wind shear, and turbulence.
G.R.

A72-28837 # Global dispersion of supersonic transport exhaust in the stratosphere. C. Berman and A. Goldburg (Boeing Co., Seattle, Wash.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 194-197. 16 refs.

A study was performed to estimate possible peak regional concentration of SST-produced emissions in the stratosphere based on expected levels of SST flight operations. Calculations were made of the magnitude of peak concentrations. This value is given graphically as a function of latitude for both spherical earth and for hemispherical earth (Northern Hemisphere).
O.H.

A72-28838 # The growth in stratospheric flight. J. F. Leach and P. Wardman (British Aircraft Corp., Ltd., Filton, Bristol, England). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 198-204.

Aircraft emissions in the stratosphere are estimated from all types of aircraft. It is concluded that the contribution of subsonic aircraft to stratospheric water vapor will be comparable to that of supersonic aircraft at least as late as 1980, although their contribution to oxides of nitrogen will be somewhat smaller. Even in 1990, the fuel burnt in the stratosphere by subsonic aircraft will still be half of that of the SST aircraft.
O.H.

A72-28840 # Computing meteorological effects on aircraft noise. R. J. Thompson (Sandia Laboratories, Albuquerque, N. Mex.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints.

Boston, American Meteorological Society, 1972, p. 209-212. 6 refs. AEC-supported research.

Description of a method for estimating the various factors, particularly wind and sound speed variations, that affect the aircraft noise propagation. The method is based on ray acoustics and can be implemented on a digital computer. Detailed attention is given to the computation of a quantity which measures the convergence of sound rays as a result of atmospheric variations. O.H.

A72-28841 * # Some analyses of the variability of atmospheric parameters at low altitudes significant for aircraft flyover noise measurements. D. T. Chang (Environmental Research and Technology, Inc., Lexington, Mass.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 213-218. Contract No. NAS1-9837.

A number of special radiosondes were examined to study the statistical variabilities of atmospheric parameters on a time and space scale commensurate with aircraft flyover noise measurements. Particular emphasis is placed on those aspects of the data which relate to the temporal variabilities of the temperature and humidity profiles. It is found that during the late morning hours, continuous surface measurements and measurements of airport tower levels are sufficient to monitor the layer of the atmosphere in which the largest variabilities occur. O.H.

A72-28843 # Some preliminary results from the FAA fog dispersal program. F. G. Coons, Jr. (FAA, Systems Research and Development Service, Washington, D.C.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 225-227.

Airport fog dispersal goals, tested techniques for accomplishing these goals, and methods used for evaluating the effectiveness of the tested techniques are briefly reviewed. One of the techniques tested made use of a DC-3 equipped with special apparatus that injects polyelectrolyte chemicals into the fog at rates less than five kg per nautical mile (n mi). Seeding was accomplished at altitudes less than 300 feet above ground level and normally within one n mi of the active runway and approach zone. M.V.E.

A72-28845 # The present and future of visibility observations. F. C. Hochreiter (NOAA, National Weather Service, Sterling, Va.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 236-242. 5 refs.

Discussion of the nature, goals, problems, and techniques of aviation visibility information. A review of the implications of observer, observation-site, and visibility-marker characteristics for sensory observations is followed by a summary of the problems encountered in sensory observations and a survey of methods of visibility measurement by instruments. M.V.E.

A72-28846 # A new concept - Sensor equivalent visibility. D. H. George and M. Lefkowitz (NOAA, National Weather Service, Sterling, Va.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 243-250. 9 refs.

Discussion of some initial attempts to develop an automated, objective visibility measure to be used in lieu of the traditional prevailing visibility observation. The 'sensor equivalent visibility' (SEV) concept denoting any equivalent of human visibility derived from instrumental measurements is intended to render sensor measurements meaningful by relating them to human visibility. The representativeness of sensor data is analyzed, and a data processing strategy is devised. Results of tests of the contemplated procedures are summarized and improvements are proposed. M.V.E.

A72-28847 # Lidar measurements of slant-range visibility for aircraft landing operations. R. T. H. Collis, W. Vizee, J. Oblanas (Stanford Research Institute, Menlo Park, Calif.), and E. Y. Moroz (USAF, Cambridge Research Laboratories, Bedford, Mass.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 251-254.

Description of a lidar experiment designed to obtain observations of slant-path visibility under conditions of low clouds and fog at the coastal site of Pillar Point, California, in the summer of 1971. The results obtained indicate that the approach is valid and, when properly applied, has potential for use in a practical system. M.V.E.

A72-28848 # Measurement and prediction of slant path visual range in airport approach zones. L. A. Wheelock, D. N. Montgomery, F. M. Bagrash, C. W. Lohkamp, G. S. Bradley, and R. D. Chipman (U.S. Navy, Research and Development Dept., Crane, Ind.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 255-258. 11 refs.

Summary of the work performed in the first phase of a three-phase program to develop and implement a slant visual range/approach light contact height measurement system intended for use at airports with Category II or lower landing minimums. Measurements are to be made which, after proper processing, can give a pilot an assessment of the approach zone visibility he can expect while conducting the approach. The summarized first phase of the program is primarily a study and mathematical modeling effort including an extensive review of past work in the field. M.V.E.

A72-28851 # Thunderstorm hazards to aircraft and their relation to the large-scale environmental setting. A. C. Modahl and W. M. Gray (Colorado State University, Fort Collins, Colo.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 271-275. 21 refs.

Discussion of observations of severe-thunderstorm-associated aircraft mishaps with a view to linking the surrounding synoptic-scale meteorological conditions to some of the conditions within the storm which are believed contributory to possible aircraft flight stability upset. The mechanics of thunderstorm intensifications and aircraft hazards are studied. It is considered that there may be a good possibility of developing hazardous thunderstorm indices based on the measured synoptic scale flow patterns. F.R.L.

A72-28852 # Thunderstorm turbulence and drafts. J. T. Lee (NOAA, National Severe Storms Laboratory, Norman, Okla.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 276-280. 5 refs.

Results of controlled penetration of thunderstorms by an F-100 aircraft. A further understanding of the hazards of turbulence can be provided by a knowledge of draft size and sudden changes in acceleration. A thunderstorm can be visualized as a number of convective cells. The diameters of the updrafts tend to increase with height, with increase in their maximum speed, and with increased storm intensity. In addition to the drafts, fluctuations of much shorter periods are encountered. These fluctuations are evidenced by changes of the acceleration on the aircraft, and increase both in severity and frequency as the radar reflectivity of the storm increases. F.R.L.

A72-28853 # Probability of encountering thunderstorms at 50,000 and 60,000 ft for selected routes over the United States. D. D. Grantham and A. J. Kantor (USAF, Cambridge Research Laboratories, Bedford, Mass.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 281-284. 6 refs.

Investigation of the probability of convective cloud encounters at SST altitudes in an effort to evaluate the potential problem of the SST vs convective clouds at altitudes of 50,000 and 60,000 ft for the most severe region, month, and hours over the U.S. An 'encounter climatology,' based on a 10-n mi-wide flight path indicates intersection with a cloud every 8000 or 9000 mi at 50,000 ft, and every 114,000 to 127,000 mi at 60,000 ft along a route between Miami and Los Angeles or San Francisco. This means roughly one encounter for every 4 flights at 50,000 ft and one for every 57 flights at 60,000 ft. F.R.L.

A72-28855 * # Prediction of hail damage to aircraft. R. J. Hayduk (NASA, Langley Research Center, Hampton, Va.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 293-297. 9 refs.

Description of a hailstone impact simulator, a valuable laboratory apparatus which can be used for such hailstone research as the testing of prospective structural designs or generating data to compare with theory. The simulator consists of a launcher and a velocity-measuring system. It has been successfully used to obtain deformation data on flat sheets and spherical caps of various sizes impacted by hailstones at typical flight velocities. A computer program is described which adequately predicts the damage to a simple structure when impacted by a hailstone. F.R.L.

A72-28856 # Aircraft icing climatology for the Northern Hemisphere. E. D. Heath (USAF, Environmental Technical Applications Center, Washington, D.C.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 298-303. 5 refs.

Formulation of definitions and assumptions stipulating criteria for aircraft icing. Radiosonde and empirical aircraft-icing data are used to illustrate that a step-by-step procedure can be developed to determine the probability of occurrence of icing. The equation derived for this procedure has a 'probable' icing and a 'potential' icing term. Climatological data accumulated through use of the potential-icing term are valuable for research and development planning for helicopter operations. Combining both the potential- and probable-icing terms gives the probability of encountering icing conditions over a station. Accumulated climatological data from the combined terms are analyzed for the Northern Hemisphere on monthly charts, which should provide a valuable tool for aircraft design and mission planning. F.R.L.

A72-28857 # A macroscale-mesoscale numerical model and the potential for forecasting severe local weather. M. L. Kaplan (USAF, Global Weather Central, Offutt AFB, Neb.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 304-310. 9 refs. Grant No. NOAA-E-22-49-70.

Establishment of a numerical model in an effort to simulate intense mesoscale development. The development of severe local weather and intense three-dimensional momentum transport are always linked within the framework of the nonlinear primitive equations of motion. The model, linking synoptic scale forcing with horizontally varying low-level boundary conditions, is capable of producing horizontal and vertical accelerations typical of the 32-km scale during intense atmospheric development. The nonlinear transport of energy in the form of four to six grid integral waves appears to be an integral feature of severe local circulations. Weather support for long distance air travel will be dependent on the ability to simulate in advance the severe local transport of momentum. F.R.L.

A72-28861 # The effect of aircraft flight conditions on low altitude critical air turbulence /LO-LOCAT/. J. W. McCloskey (Dayton, University, Dayton, Ohio). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 326-331. 7 refs.

Development of an analytical procedure for relating turbulence parameters to a wide range of low level flight conditions recorded for each leg of five and one-half minutes duration. The gust velocity time history was recorded, filtered to eliminate drift and aircraft motion from the data, and finally decomposed into three orthogonal, space oriented gust velocity components. A linear model is established in an attempt to identify various flight conditions which will be useful in the prediction of clear air turbulence. F.R.L.

A72-28862 # Aspects of the influence of low-level wind shear on aviation operations. K. A. Kraus (FAA, Systems Research and Development Service, Washington, D.C.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 332, 333. 9 refs.

Consideration of the occasional, unusual, or extreme wind shear event that presents itself as a problem in aircraft control. This is becoming more important with the increased requirement for design precision and demand for maximum utilization of aircraft and facilities. An important aspect of wind shear occurs during a light and variable surface wind. When such conditions exist and the controller is not aware of the low-level winds, he may not select the best active runway. The ideal system of the future would measure the vertical wind environment without requiring probes such as balloons or INS-equipped aircraft. F.R.L.

A72-28863 # Operational prediction of southwestern mountain waves. R. B. Boulay, G. A. Hasen, and D. M. McEligot (Arizona, University, Tucson, Ariz.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 334-340. 10 refs.

Investigation of the feasibility of using winds aloft forecasts from the National Weather Service to predict lee wave behavior for general aviation. Since Federal Air Regulations concerning oxygen requirements effectively prohibit most light aircraft from exceeding 12,500 ft MSL for cross-country flights, major attention is concentrated on predictions and aircraft observations below that altitude. However, higher altitude sailplane measurements are also included, since lee waves provide a mode of cross country flight for that section of general aviation. F.R.L.

A72-28864 # Turbulence and mesoscale temperature gradients in the lower stratosphere. J. I. MacPherson (National Research Council, Ottawa, Canada) and E. G. Morrissey (Atmospheric Environment Service, Toronto, Canada). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 341-346. 11 refs.

Results of the COLDESCAN Canadian-American cooperative project to study stratospheric turbulence. An RB-57F aircraft, capable of sustained flight above 60,000 ft, was fitted with a unique event recorder and instrumentation system designed to record incidents of turbulence and horizontal temperature gradients encountered on routine stratospheric flights. It was found that light-to-moderate stratospheric turbulence occurred about 0.5% of the time above 40,000 ft, tended to be concentrated over mountains near tropospheric jet streams, and had an above-average frequency of occurrence at 50,000 ft. More frequent, and perhaps more important in SST operations, were the encounters with temperature waves and horizontal temperature gradients exceeding 2.5 C in 3 n mi. F.R.L.

A72-28865 # Limited shear zones - A hazard to aviation. R. J. Becker and K. S. Gage (Maryland, University, College Park, Md.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints.

Boston, American Meteorological Society, 1972, p. 347-352. 5 refs. Research supported by the Research Corp.; Contract No. AT(40-1)-4199.

Consideration of the dual hazard to aviation posed by turbulence and shear in a stably stratified environment. The erratic response of an aircraft to CAT may be due at least in part to variations in the lift experienced by the aircraft as it penetrates a layered structure containing thin laminae with concentrated vertical shear. It appears that for the greatest probability of obtaining smooth flying conditions every attempt should be made to avoid flying through narrow, intense baroclinic zones where strong shear is likely to be found concentrated in very stable layers. F.R.L.

A72-28867 * # Meteorological parameters versus CAT encountered in the stratosphere by the XB-70 airplane. J. R. Scoggins (Texas A & M University, College Station, Tex.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 361-366. 18 refs. Grant No. NGR-44-001-081.

Frequency distributions prepared from synoptic meteorological parameters associated with turbulent and nonturbulent conditions encountered by the XB-70 aircraft at altitudes generally between 12 and 20 km in the stratosphere show that turbulence is associated with certain ranges or critical values of the parameters. Certain combinations of the variables are associated with turbulence for at least one-fourth to one-third of the observations. G.R.

A72-28868 # Aeronautical requirements for observations and instruments at aerodromes. M. E. Nancoo (International Civil Aviation Organization, Montreal, Canada). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 367-370.

ICAO establishes aeronautical requirements for the type and frequency of meteorological information needed for takeoff and landing. The presentation of the requirements is discussed, giving attention to surface wind, visibility, runway range, slant visual range, present weather, cloud, temperature and dew point, and pressure. The instrumentation for meeting the requirements is discussed together with approaches for the upgrading of overall aeronautical meteorological observing and reporting systems. G.R.

A72-28869 # Weather information for vertical and short takeoff and landing /V-STOL/ aircraft. A. Hilsenrod (FAA, Systems Research and Development Service, Washington, D.C.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 371, 372. 5 refs.

Detailed meteorological information is needed for the optimization of the design of the stability and control features of V-STOL aircraft and a number of other factors, including the location of a V-STOL port, and a technique of forecasting the meteorological parameters significant to V-STOL port operations. These objectives are expected to be achieved through a program designed to determine the type of meteorological information required. Approaches for obtaining the required data are also considered. G.R.

A72-28871 # A cost effectiveness model for evaluating aviation weather dissemination techniques. H. Newhouse (NOAA, National Weather Service, Silver Spring, Md.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 375-380.

The primary impetus for the development of the model was related to the problem of satisfying the ever-increasing weather briefing requirements of the general aviation pilot. The modeling process involved some subjective judgment in establishing certain basic measurements such as the demand existing in a given area and the demand served by any dissemination facility installed in that area. The results of some of the model exercises are discussed, giving attention to various sets of dissemination techniques, design variables, and time periods. G.R.

A72-28874 # Uses of aircraft reports in ocean analyses and forecasts. J. Vederman (NOAA, National Weather Service, Los Angeles, Calif.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 393-396.

The acquisition of meteorological reports from aircraft in flight (AIREPS) in the Pacific area is discussed. The computer processing of these reports to obtain daily analyses, five-day means, and monthly and seasonal means is described. Finally, principles for producing prognoses from AIREPS are dealt with. O.H.

A72-28875 # The case for high design cruise altitude for advanced transports. C. L. Chandler and J. T. Davis (Delta Air Lines, Inc., Atlanta, Ga.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 397-400.

The 40,000 to 50,000-ft altitude band is explored as the cruise regime for commercial transports utilizing 'Advanced Technology' - i.e., innovations in propulsion, structures, avionics, controls, and aerodynamics - which have to be introduced in the late seventies or early eighties. Operational advantages of the high-altitude cruise regime is discussed, and the corresponding implications for aircraft design are outlined. O.H.

A72-28876 # Stratospheric flight and meteorology initial data on Concorde. C. Dousset, R. Joatton, and R. Stuckelberger (Société Nationale Industrielle Aérospatiale, Paris, France). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 401-408.

The effects of stratosphere meteorology (temperatures, winds, and turbulences) on the performance, fuel consumption, and other operating factors are studied for the case of long-haul transports, such as Concorde. Emphasis is placed on the aircraft's dynamics and on the aspects of passenger comfort. Initial results of temperature and acceleration measurements already conducted on the Concorde prototype are presented, and planned meteorological measurements and tests are outlined. O.H.

A72-28877 # High-resolution pressure-altitude measurements from aircraft. E. J. Frey, R. B. Harlan (MIT, Cambridge, Mass.), and P. M. Latron (Direction Technique des Engins, Puteaux, Hauts-de-Seine, France). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 409-416. Contract No. AF 19(628)-5546.

An airborne gravimetry experiment has been carried out which has yielded high-resolution pressure and altitude data. The experiment has confirmed that the combination of suitable altimetry and pressure measurement provides a method for making broad spectrum measurements of the variations in isobar surface from an aircraft. O.H.

A72-28879 # Future patterns of aircraft operations and fuel burnouts with remarks on contrail formation over the United States. W. B. Beckwith (United Air Lines, Inc., Chicago, Ill.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 422-426. 12 refs.

An attempt is made to forecast turbine aircraft fuel burnouts to obtain data necessary for estimating the total effects of exhaust products on air quality. Altitude, seasonal, and latitudinal variations in fuel burnout are examined. The problem of contrail formation is discussed, and preliminary contrail observational findings are presented. O.H.

A72-28954 # Development of a graphite horizontal stabilizer. G. M. Lehman (Douglas Aircraft Co., Long Beach, Calif.) and A. Manno (U.S. Naval Air Development Center, Warminster, Pa.). AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-358. 12 p. Members, \$1.50; nonmembers, \$2.00. Contract No. N00156-70-C-1321.

Development of a graphite-epoxy aircraft structure is traced through design synthesis, development testing, tooling, manufacturing, and initial ground testing. Structural arrangements and design details are discussed for an A4 Skyhawk horizontal stabilizer utilizing Narmco 5206 material in the primary structure. Design and manufacturing techniques developed through fabrication and testing of selected structural components and a full-scale stabilizer are described. Component test results and the concomitant changes to the stabilizer design are discussed. Processing methods are summarized and comparisons are made for graphite-epoxy laminates, other laminates, and aluminum alloys regarding the practical aspects of the design manufacturing interface. Natural vibration modes and frequencies are compared between the production metal stabilizer and the composite stabilizer which weighed 28 per cent less. (Author)

A72-28955 * # Advanced transport structures and materials technology. R. L. Goble (NASA, Langley Research Center, Hampton, Va.). AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-362. 7 p. Members, \$1.50; nonmembers, \$2.00.

A program was undertaken regarding the economic benefits attainable through the application of advanced technologies to the

next generation of long-range transport aircraft in the Mach number range from 0.85 to 1.0. In addition to airframe studies, two parallel engine systems studies contracts are also in progress. The manufacturability of composites promises structural concepts which can take forms very similar to those employed in conventional structures or forms very different from conventional approaches. It is pointed out that the findings of the studies discussed justify a considerably expanded effort not only in composite materials but also in other technologies. G.R.

A72-28958 # Concorde dynamics - A review. H. P. Y. Hitch (British Aircraft Corp., Ltd., Commercial Aircraft Div., Weybridge, Surrey, England). AIAA, ASME, and SAE, Structures, Structural Dynamics, and Materials Conference, 13th, San Antonio, Tex., Apr. 10-12, 1972, AIAA Paper 72-381. 5 p. Members, \$1.50; nonmembers, \$2.00.

The experiences to date concerning Concorde dynamic behavior in flight are reviewed, and some comparisons with prediction are made. Discussed are the effect of the integrated design; wing, fin, and elevator flutter; gust and runway response; and engine surges. Finally, some thoughts on dynamic problems in general are presented. O.H.

A72-28971 Deposition characteristics of lubricants developed for aircraft gas turbine engines. F. E. Salb, W. D. Smock, and F. K. Lea (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). American Society of Lubrication Engineers, Annual Meeting, 27th, Houston, Tex., May 1-4, 1972, Preprint 72AM 14. 7 p. Members, \$1.50; nonmembers, \$2.00.

Laboratory test data are tabulated and presented on the thermal stability characteristics of various aviation grades of synthetic lubricants as determined by a modified deposition test. The deposition test was originally modified by the engine builder when a need existed in screening aviation synthetic lubricant prior to full-scale engine tests. Lubricants discussed relative to deposition characteristics cover the period from 1956 to the present day.

(Author)

A72-29013 # Information theory approaches to navigation. I - A prospect of navigation. E. W. Anderson (Smiths Industries, Ltd., Wembley, Middx., England). Journal of Navigation, vol. 25, Apr. 1972, p. 141-152.

The philosophy underlying current navigation procedures is discussed in terms of information theory. The concept of entropy is introduced as a measure of randomness, and its reduction through the work performed by the navigator is examined. The basic concepts are illustrated and applied to problems of traffic control. The problem of collision avoidance is reviewed, along with the procedures of traffic control communications. The capabilities and limitations of the computer as an aid in traffic control are assessed.

M.V.E.

A72-29014 # Approach and landing guidance for civil aviation. K. A. Wood (Department of Trade and Industry, London, England). Journal of Navigation, vol. 25, Apr. 1972, p. 176-186; Discussion, p. 186-191.

Review of the history and evolution of the ILS concept and practice, and assessment of present and future ILS needs and trends. The status of modern ILS facilities in relation to expected operational requirements is examined. System proposals toward the establishment of an internationally agreed solution are discussed.

M.V.E.

A72-29073 # Effect of the chemical composition of jet fuels on their antiwear properties (Vliianie khimicheskogo sostava reaktivnykh topliv na ikh protivoznosnye svoystva). A. F. Aksenov, K. S. Chernova, V. G. Spirkin, S. G. Klimov, A. E. Borodin, V. P. Belianskii, V. I. Terekhin, Iu. G. Nekipelov, and A. Ia. Shepel'.

Khimiia i Tekhnologiya Topliv i Masel, vol. 17, no. 2, 1972, p. 41-44. In Russian.

Antiwear properties of jet fuels and various hydrocarbon groups have been investigated on experimental setups simulating sliding friction and rolling in the temperature range from 20 to 120 C. It has been found that the antiwear characteristics of hydrocarbon groups of these fuels deteriorate in the following order: bicyclic aromatic hydrocarbons, naphthenes, and paraffins. Insignificant amounts of oxygen compounds that are formed during self-oxidation improve the fuel antiwear properties. Antioxidant additives have the same effect. O.H.

A72-29090 Measurement of the damping properties of silicone-based elastomers over wide temperature ranges. C. T. Coote (Southampton, University, Southampton, England). *Journal of Sound and Vibration*, vol. 21, Mar. 22, 1972, p. 133-147. 19 refs.

Measurement of some dynamic shear properties of silicone-based elastomers over wide temperature ranges. The work arose out of a need to find a suitable material for use in artificial damping treatments applied to aircraft panels to reduce the response to acoustic excitation. The material selected had to operate satisfactorily over the wide temperature range encountered in the aircraft environment. An apparatus was developed to measure the real part of the shear modulus and loss factor over the temperature range from -60 to +150 C. Tests were conducted over a frequency range of from 200 to 1000 Hz at various strain levels up to 1%. Tests on the most promising material were extended to determine the dynamic shear properties at subambient temperatures. Investigations were also made to determine the sensitivity of the dynamic shear properties to changes in material filler content and strain applied. An error analysis was performed to ensure no magnification of experimental error in calculating results from the measured data. The most satisfactory performance was obtained from a fluorinated silicone rubber having a shear modulus of 1700 lb/sq in. (1,200,000 kg/sq m) to 60 lb/sq in. (42,200 kg/sq m) and a loss factor of 0.7 to 0.2 over the temperature range from -60 to +150 C. (Author)

A72-29096 A general method with shaping filters to study random vibration statistics of lifting rotors with feedback controls. G. H. Gaonkar. *Journal of Sound and Vibration*, vol. 21, Mar. 22, 1972, p. 213-225. 30 refs.

Study of the random vibration statistics of linear or perturbed linear dynamic systems with variable parameters, in particular, of lifting rotors with feedback controls. By introducing shaping filters to random inputs, the response variance matrix is solved directly from another set of linear equations. Therefore, with the stipulation of stationary Gaussian random inputs, the computational scheme of response threshold crossing statistics under steady-state conditions is essentially no more involved than generating the state vector to step inputs. For certain types of feedback controls of lifting rotors having coupling effects between blades, the equations of motion studied by other means using blade coordinates are adopted. Treated for illustrative purposes are the rigid flapping oscillations of multibladed rotors at a high advance ratio, having a rigid hub with elastically restrained and centrally arranged flapping hinges. The numerical results of the flapping response statistics include the root-mean-square description and the expected values of threshold up-crossings per unit time. When compared to earlier related studies, the proposed method requires negligible core storage requirement, directly permits variable step sizes to guarantee preset accuracy criteria, and offers substantial saving in machine time. (Author)

A72-29131 # Moment characteristics of a small-aspect-ratio wing in a bounded inviscid fluid flow (Momentnye kharakteristiki kryla malogo udlinaeniia v ogranichenno potoke neviaskoi zhidkosti). V. I. Kholiavko and Iu. F. Usik. *Samoletostroenie i Tekhnika*

Vozdushnogo Flota, no. 25, 1971, p. 3-8. In Russian.

The positions of the aerodynamic center and the center of pressure of a slender flat small-aspect ratio wing moving near a solid or free surface are analyzed on the basis of the general relations in slender body theory and approximate relations for the virtual mass. Formulas for calculating the position of the center of pressure at small angles of attack are obtained, together with quantitative estimates of the influence of the angle of attack on the position of the center of pressure. The influence of the derivatives of the center of pressure with respect to the angle of attack and with respect to the flight altitude on the longitudinal static stability of a small-aspect-ratio wing is examined. V.P.

A72-29136 # Electrical simulation of nonstationary gas motions in the intake and exhaust systems of internal combustion engines (Usloviia elektricheskogo modelirovaniia nestatsionarnogo dvizheniia gaza v sistemakh vpuska i vypuska DVS). D. A. Munshukov. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 25, 1971, p. 35-43. 8 refs. In Russian.

An electrical analog is proposed which uses units imitating cylinder, turbine, and supercharger operation to simulate the intake and exhaust of gas masses. Equations describing the characteristics of these units are derived. V.P.

A72-29137 # Experimental procedure for determining the dynamic parameters of a turboprop engine as a system subject to control of the number of revolutions (K metodike eksperimental'nogo opredeleniia dinamicheskikh parametrov turbovinovogo dvigatel'ia kak ob'ekta regulirovaniia chisla oborotov). P. P. Minin and A. K. Ipatov. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 25, 1971, p. 43-46. In Russian.

A turboprop engine treated as a system subject to control of rotational speed is characterized by the time constant of the engine, the gain factor with respect to fuel supply, and the gain factor with respect to the blade angle. A procedure for obtaining these dynamic parameters is proposed, which is based on determining the transient response (with respect to the number of revolutions) to instantaneous changes in the fuel supply at a fixed blade angle corresponding to the specific mode of engine operation being studied. The required small modifications of the engine are described. V.P.

A72-29138 # Determination of the alignment parameter of a compensating network in the gas temperature regulating system of an aircraft gas turbine engine (Opredelenie parametra nastroiiki korrektsionnogo kontura, rabotaiushchego v sisteme regulirovaniia temperatury gaza aviatsionnogo GTD). Iu. N. Dotsenko, I. P. Pelepeichenko, and V. G. Volkov. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 25, 1971, p. 46-50. 5 refs. In Russian.

A procedure is proposed for determining the time constant of a thermocouple situated in the gas flow in front of the turbine, and intended for operation in engine's temperature regulating system. The determination of the time constant is preceded by the determination of the temperature and flow rate of the gas with the aid of two thermocouples differing in rise time. A method of converting the time constant of the thermocouple for various modes of operation is proposed. V.P.

A72-29143 # A limiting property of thin-walled minimum-weight systems, and its utilization in optimal design (Ob odnom predel'nom svoistve tonkostennykh sistem minimal'nogo vesa i ego ispol'zovanii dlia optimal'nogo proektirovaniia). V. M. Riabchenko. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 25, 1971, p. 72-79. 10 refs. In Russian.

The optimal design of systems, composed of ribs, diaphragms,

and skins, by a discrete matrix force method with the aid of a momentless computational scheme (which is also broken down into discrete elements) is examined. Using the general properties of linear programming, it is shown that a thin-walled minimum-weight system is statically determinate, provided a single type of loading is considered and the smallest permissible values of the variable parameters are taken as zero. Since for aircraft structures, a degeneration of the skin is inadmissible, this property may be termed a limiting one. It is shown that this property can be used to determine the optimum system parameters. V.P.

A72-29147 # Investigation of the service life of Duralumin subjected to repeated axial tension impact and nonimpact loads (Issledovanie dolgovechnosti diuraliumina pri povtornom osevom rastiazhenii udarnymi i bezudarnymi nagruzkami). V. Ia. Slobodianiuk. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 25, 1971, p. 94-97. In Russian.

Stress/service life relations are derived for smooth Duralumin samples and samples with various stress raisers from conventional and impact fatigue tests. Quantitative estimates on the influence of impact tensile loads on the durability and notch sensitivity of Duralumin are obtained from a comparison between conventional and impact fatigue data for identical samples. V.P.

A72-29179 # Application of the statistical trial method in modeling an air situation and the air traffic control process (Primenenie metoda statisticheskikh ispytaniy dlia modelirovaniia vozdushnoi obstanovki i protsessa upravleniia vozdushnym dvizheniem). O. A. Tiurin and O. P. Savel'ev. In: Adaptive systems. Large systems. Moscow, Izdatel'stvo Nauka, 1971, p. 512-520. In Russian.

The organization, performance and structure of airport air traffic control systems are discussed as the characteristics of a mass-scale public service system. The statistical trial method is applied to air traffic control at a single airport using a Poisson distribution law for aircraft arrivals in different air situations and weather conditions. Factors affecting the efficiency and smooth operation of an air traffic control system are covered. Optimal numbers of aircraft tracking channels are calculated for various air traffic situations. V.Z.

A72-29186 The accuracy of corrected OMEGA close to a transmitter. R. Couzens (Royal Aircraft Establishment, Radio Dept., Farnborough, Hants., England). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington, D.C., Institute of Navigation, 1971, p. 54-55e.

Description of a series of flight tests carried out in May 1971 to assess the accuracy of navigation at ranges of less than 500 nm from an Omega transmitter (Norway) during the period when the dawn line was between Norway and Omega Trinidad and New York. Omega readings were taken in an aircraft flying at 10,000 ft and were compared with a ground fix obtained by means of vertical photography. Diurnal corrections were applied from ground monitors situated at either end of the flight path. The error between the ground fix and corrected Omega fix is presented as a function of range from the Omega Norway transmitter. A comparison is made between the measured diurnal variation at the monitor sites and that predicted from the sky wave correction tables. Similar measurements were taken at a point remote from the transmitter. (Author)

A72-29191 # The AN/ARN-99/V/ airborne OMEGA navigation set - Capabilities and status. J. A. Rey (Northrop Corp., Hawthorne, Calif.) and F. C. Sakran, Jr. (U.S. Naval Air Test Center, Patuxent River, Md.). In: OMEGA Symposium, 1st, Washington,

D.C., November 9-11, 1971, Proceedings.

Washington, D.C., Institute of Navigation, 1971, p. 89-98. 6 refs.

Following a brief description of the Omega airborne navigation system, the particular features associated with the installation and performance of the system are discussed. Results of flight test experience on several vehicles are outlined, and accuracy statistics of one U.S. Navy flight test program is presented. O.H.

A72-29192 # Use of composite OMEGA in aircraft applications. O. J. Baltzer (Tracor, Inc., Austin, Tex.). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington, D.C., Institute of Navigation, 1971, p. 99-105.

Study of the utilization of 'composite Omega' as a possible means of circumventing any requirement for skywave corrections (SWCs) in aircraft navigation. In the composite Omega concept, the phase data at separate carrier frequencies (e.g., 10.2 and 13.6 kHz) are linearly combined, with appropriate weighting coefficients, so as to form a 'composite' signal. Such a signal may possess certain advantages over either carrier signal alone or over the simple difference-frequency signal. Phase data at 10.2 and 13.6 kHz, as obtained at various locations, have been analyzed in terms of an equivalent composite Omega signal; nomographs are presented to show the effects of varying the linear weighting ratio of the individual carrier frequencies. In most cases the use of composite Omega offers an improvement (in terms of diurnal stability and navigational accuracy) over that obtainable with uncompensated difference-frequency navigation or with either carrier frequency alone (without SWC). Thus in many instances the data presented confirm the earlier conclusions given by Pierce (1968); however, in other instances, composite Omega appears to offer little advantage. (Author)

A72-29195 # FAA airborne OMEGA development program. G. H. Quinn (FAA, Washington, D.C.). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington, D.C., Institute of Navigation, 1971, p. 130, 131. FAA-sponsored research.

This paper deals with on-going and planned Omega projects sponsored by the FAA Systems Research and Development Service. Existing Omega projects include a signal monitoring program in Canada, an airborne signal data collection project in cooperation with NOAA, and an operational evaluation of the AN/ARN-99 Omega System on a commercial airliner. Planned projects include evaluation of a differential Omega system, development of a 3.4 kHz or composite Omega airborne system, evaluations of low cost VLF/Omega equipment, and development of a civil aviation Omega system including the most promising techniques found in preceding investigations. (Author)

A72-29197 # The effect of OMEGA on oceanic airway safety. J. A. Sorensen, D. E. Stepner, and J. S. Tyler, Jr. (Systems Control, Inc., Palo Alto, Calif.). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington, D.C., Institute of Navigation, 1971, p. 138-143. 16 refs. U.S. Department of Transportation Contract No. TSC-260.

Future reduced lateral lane separation standards between air routes over the North Atlantic will be required because of the projected increase in aircraft traffic. To enable this reduction, a means of independently monitoring each aircraft position or updating the onboard dead reckoning system may be necessary. The application of Omega for these purposes is considered. The Omega system, inertial navigation systems (INS), and typical air traffic control procedures are modeled as a means of relating the lateral lane separation to probability of position overlap between aircraft on

adjacent routes. It is shown that to maintain a satisfactory level of safety with today's INS accuracies, the lateral separation can probably be reduced to 45 n.mi. without Omega. Using Omega either for surveillance or as an onboard navigation aid allows the lateral separation to be reduced to 30 n.mi. or less. (Author)

A72-29198 # Development and flight-testing of pre-production OMEGA aircraft receivers and antennas. R. I. Eisenberg, A. F. Thornhill, and M. F. Williams (U.S. Navy, Naval Research Laboratory, Washington, D.C.). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings.

Washington, D.C., Institute of Navigation, 1971, p. 144-154. 6 refs. FAA-supported research.

Description of the development and flight testing of the Mark I, Mark II, and Mark III Omega aircraft receivers, and the vertical and crossed-loop antenna systems for Omega aircraft receivers. The Mark I flight tests indicated that in-flight geodetic accuracies of one to two nautical miles or better were attainable with Omega. The chief disadvantages of the Mark I were lack of automation and signal loss in high noise conditions, particularly those caused by precipitation effects on the aircraft. The Mark II Omega aircraft receiver used hard-limiting RF circuits and automatic dead reckoning circuits to overcome signal loss problems when flying in high noise or precipitation environments. Signal loss during precipitation static conditions was still a problem during early flight tests of the Mark II. However, the later use of a crossed-loop antenna and coupler greatly reduced this problem. The Mark III displays include aircraft position in latitude/longitude range and bearing to enroute destinations, cross-track error, and autopilot commands. The Mark III equipment provided one- to two-mile rms geodetic accuracy during flight tests. (Author)

A72-29199 # Standardization of aeronautical navigation/guidance enabled by OMEGA. B. Dworkin (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington, D.C., Institute of Navigation, 1971, p. 155-164.

Description of a plan for a program acronymed 'SANG' (Standardized Aeronautical Navigation/Guidance) designed to develop standards covering the life cycle of sensor and computer equipments widely applicable as aeronautical navigation/guidance modules and producible by industry as competitive product lines. With the broad-based market enabled by the enforced use of standards as an incentive, candidate standardization units would be developed by industry with the same design genius and other resources which it normally applies in seeking a competitive edge for its widely marketable product lines, as opposed to the case of a specialized government subsidized product. The role of the government would be the funded development of standards to meet the user-customer needs, the conduct of tests upon industry's candidates at a standardized avionics qualification test facility, and the enforced conformance (at least by the government controlled users) to the systematically developed standards for procurement, operation, maintenance, and logistics. Thus the aeronautical system developer would be provided with a 'shelf' of qualified modules over several performance ranges which he can select on the basis of economic and schedule merits without being saddled with a costly unique development of a critical subsystem. (Author)

A72-29200 # OMEGA polar navigation performance. C. A. Leaver (USAF, Offutt AFB, Neb.). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings.

Washington, D.C., Institute of Navigation, 1971, p. 165-172.

Satisfactory OMEGA polar performance has been demonstrated.

Present problems of poor geometry and signal strength require a filter approach to combine OMEGA and rate aiding sensor data. Most of these constraints will disappear with implementation of the full power transmitter network. Polar accuracy is moderate - 3.25nm (day) to 3.6nm (night). Cruise vehicle dynamics do not pose a problem. The long range reconnaissance mission requires a backup navigation capability now provided by an additional navigator. This task was successfully mechanized by equipment modification to incorporate four highly successful additional features unassociated with OMEGA. These features included a selectable grid reference, and subroutines for Multiply Parallel DR, Manual Celestial computation and Multiple Bearing resolution. The strategic reconnaissance aircraft and mission provided the author a near-perfect vehicle to achieve these results at virtually no cost to the Air Force. (Author)

A72-29201 # The flyability of raw OMEGA phase data. R. H. McFarland (Ohio, University, Athens, Ohio). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington, D.C., Institute of Navigation, 1971, p. 173-177. 5 refs.

Demonstration that practical use of the direct current of raw Omega phase information presented on a conventional ID-249 course deviation indicator is effective in navigating a small aircraft flying over course segments ranging from 10 to 400 miles. Omega hyperbolic lines of position, in general, are relatively parallel with very little curvature only several hundred miles from a station. These lines can be flown or tracked much the same as VOR radials but with the advantage of nearly constant lineal deviation sensitivity. Results of some flight experiments using a small aircraft are presented which clearly indicate that these lines of position, or selected intermediate lines, can be tracked with tolerances less than one nautical mile referencing only the course deviation indicator. Right-left positional information augmented with lane counts is found to provide good reference for flights operating over 300- to 400-mile routes. Selecting stations for which the terminator is cutting the transmission path, executing rapid changes in course, and flying noisy atmospheric conditions reduces the accuracy available from contemporary equipment. Improvements in antenna design and signal processing are identified as being very necessary for full utilization of Omega. (Author)

A72-29202 # Integration and flight test of an OMEGA receiver with the P-3C aircraft navigation system. K. H. Hawkes, Jr. and D. Birnbaum (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings.

Washington, D.C., Institute of Navigation, 1971, p. 190-201. 5 refs.

OMEGA is a very low frequency radio navigation system suitable for use by ships, aircraft and submarines. A net work of four stations was established under the Navy's direction toward a final configuration of an eight station world wide long range radio navigation system. As part of the Navy's development program for an airborne OMEGA navigation set, a receiver-converter was developed specifically to interface with the central computer in the P-3C aircraft, and provide a position update for geographic navigation. This paper will describe the P-3C OMEGA navigation integration and maintainability program for a production aircraft system, a flight test program, a laboratory replay program to give the capability of testing the various rate aiding sources, a laboratory simulation program to exercise the software mechanization over the parametric range of the variables, and present preliminary results from the flight test and the laboratory simulation. (Author)

A72-29203 # Effects of weather on airborne OMEGA. S. J. Lubin and B. M. Lewis (NOAA, Environmental Research Laboratories, Miami, Fla.). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington,

D.C., Institute of Navigation, 1971, p. 202-206. 5 refs.

The Research Flight Facility of the National Oceanic and Atmospheric Administration (NOAA) is engaged in flying in and around all types of weather phenomena. Since the summer of 1969 the RFF has had a Tracor 7007B OMEGA System installed on at least one of the RFF aircraft. Further, since August 1970, the OMEGA information has been digitized and recorded on the aircraft digital recording system. The National Hurricane Research Laboratory of NOAA has been evaluating the information collected. Due to the severe weather encountered in hurricanes, snow storms, and around thunderstorms, it has become apparent that certain adverse weather definitely affects the operation of airborne OMEGA. This paper will describe these effects utilizing both E- and H-field antenna. (Author)

A72-29204 # Design of an aircraft-oriented OMEGA receiver. J. R. Thumm (Ohio, University, Athens, Ohio). In: OMEGA Symposium, 1st, Washington, D.C., November 9-11, 1971, Proceedings. Washington, D.C., Institute of Navigation, 1971, p. 207-211. 8 refs.

In order to make the Omega system useful for aircraft navigation, it is necessary to reduce the time constants involved with phase comparison averaging. This requires that maximum information be derived from each Omega segment as it appears. Conventional methods used to extract Omega signals from a noisy environment have been blanking, limiting, and high Q-band pass filters. This paper investigates the application of a subtraction circuit as an alternative to blanking in eliminating impulse noise at the front end of an Omega receiver. (Author)

A72-29347 Design problems of airborne antennas used for radio links to satellites. R. Reitzig (Siemens AG, Zentral-Laboratorium für Nachrichtentechnik, Munich, West Germany). (Institute of Electrical and Electronics Engineers, EUROCON 71, Lausanne, Switzerland, Oct. 18-22, 1971.) *Nachrichtentechnische Zeitschrift*, vol. 25, Apr. 1972, p. 187-192. Research supported by the Bundesministerium für Bildung und Wissenschaft.

Satellite systems for aeronautical communications and air traffic control are discussed. Aircraft antenna system requirements, and suitable systems of low-gain, medium-gain, and high-gain antennas are considered. A beam-steering system of least complexity is proposed which permits simultaneous and independent dual-beam operation at a single frequency. O.H.

A72-29461 # Algorithm for calculating the sections of the general position of surfaces formed by equidistant sections in the adaptation of the problem to a digital computer (Algoritm rascheta secheniia obshchego polozeniia poverkhnosti, obrazovannykh ekvidistantnymi secheniiami pri postanovke zadachi na ETsVM). S. M. Zamalin. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 26, 1971, p. 57-63. 5 refs. In Russian.

A computer algorithm is proposed for calculating the surfaces of such aircraft elements as fuselages and engine and landing-gear nacelles. It is based on the reproduction of the graphic structure of the contours of the elements by the method of successive approximations in combination with the mathematical method of conic sections. V.P.

A72-29462 # Fuselage of the AN-2m aircraft prepared from fiberglass-reinforced plastics (Fizeliakh samoleta AN-2m iz stekloplastikov). A. F. Pil'nik, L. A. Kolesnikov, Ia. S. Karpov, and V. E. Gaidachuk. *Samoletostroenie i Tekhnika Vozdushnogo Flota*, no. 26, 1971, p. 63-66. In Russian.

The experience obtained in the production of fiberglass-reinforced fuselage compartments of the AN-2m aircraft is discussed.

Particular attention is given to the preparation of joints between panels of the same material and joints between metal and plastic compartments. In addition to simplicity, the use of fiberglass-reinforced plastics is shown to provide substantial weight savings. V.P.

A72-29487 # Effect of some types of aviation fuels on the endurance of steel 45 (Vliianie nekotorykh sortov aviatsionnykh topliv na vyнослиvost' stali 45). A. F. Aksenov and V. T. Sharai (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Fiziko-Khimicheskaya Mekhanika Materialov*, vol. 8, no. 1, 1972, p. 113-115. In Russian.

It has been found that, in the range of room temperatures, the endurance limit of steel 45 in the presence of aviation fuels slightly increases. It is also shown that this effect depends on the type of fuel and additions to it. Graphical representations for fuels and additions investigated are given. O.H.

A72-29554 Introductory address for the Purdue noise conference - Noise and society. E. J. Richards (Loughborough University of Technology, Loughborough, Leics., England). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971.

Lafayette, Ind., Purdue University, 1972, p. 1-18.

Exposition of efforts which can be made toward a better and more realistic control of the acoustical environment by introducing over a period of time a system of accountancy and control of noise in the three major areas of occupational deafness, traffic location, and airport design. It is considered that acoustical pollution must be quantified in a manner wherein which the claims of technological innovation and growing industrialization can be countered realistically. F.R.L.

A72-29561 An airport zoning ordinance. T. Rose (Joiner-Pelton-Rose, Inc., Dallas, Tex.). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 249-256. 12 refs.

Recommendation of the use of zoning in conjunction with building code modifications which require soundproofing of a building which houses noise-sensitive activity. By adding the soundproofing requirement, sensitive activities can be placed closer to the airport, in a higher noise zone, than would otherwise be possible. By allowing sensitive areas to locate closer to the airport, a wider choice of land use is available in the noise-affected areas. The discussion deals with the Dallas-Fort Worth Regional Airport. F.R.L.

A72-29568 * Aircraft noise sources - A review. H. H. Hubbard (NASA, Langley Research Center, Hampton, Va.). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 347-351.

Attempt to identify the main sources of noise in various types of power plants, and to indicate trends in design and operations that are beneficial in noise control. Information is presented for such noise sources as jet exhausts, fans, high-lift devices, and unducted rotors. It is shown that lower noise levels are generally associated with lower airfoil velocities and lower pressure ratios. F.R.L.

A72-29569 Aircraft fan and compressor noise generation - A review. G. Reethof (Pennsylvania State University, University Park, Pa.). In: Noise and vibration control engineering; Proceedings

of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 352-360. 24 refs.

Review of mechanisms of noise generation in fans and compressors, taking qualitative and analytical considerations into account. The types of discrete tone sources resulting from the wake interaction mechanisms are mass flow fluctuations from rotor and stator airfoils, and fluctuating lift forces from rotor and stator airfoils. Certain of the basic simplifying assumptions result in discrepancies. It is suggested that current prediction equations for compressor noise appear to lag considerably behind current understanding of the noise generating mechanisms and transmission. F.R.L.

A72-29570* Discrete rotor noise. S. E. Wright (Southampton, University, Southampton, England; George Washington University, Washington, D.C.; NASA, Langley Research Center, Hampton, Va.). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 361-368. 7 refs.

Description of a single unified theory to account generally for the discrete radiation from the whole family of heavily loaded axial flow rotors, including helicopter rotors, propellers, and compressors. The approach used is to analyze, in a Fourier way, the periodic blade loading variation (azimuth profile) into blade loading harmonics (BLH) and then sum the total radiation from each BLH. The basic differences between high and low solidity rotor spectrums are considered, emphasizing the difference between subsonic and supersonic rotor noise. The special effect of helicopter blade slap and compressor rotor-stator interaction is discussed, and measured rotor spectrums have been included to help illustrate the theory. F.R.L.

A72-29571 Noise characteristics of quiet propellers for STOL aircraft. F. B. Metzger and B. Magliozzi (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971.

Lafayette, Ind., Purdue University, 1972, p. 369-376.

Noise is a critical parameter in the development of STOL transport aircraft for city center operation. As a result of interest in minimizing noise, an extensive program has been conducted to establish the noise signature of low tip speed propellers suitable for STOL aircraft. Measurements were made for various propeller configurations under static, taxi, and flyover conditions. Using this information, the effect of aircraft speed on perceived noise level of an aircraft in flight is projected. Also, the signature of this new quiet propeller is compared with that of existing STOL turboprop aircraft.

(Author)

A72-29576 Engine inlet noise resulting from shock wave impingement. D. M. Zallen. In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 405-409. 15 refs.

An analysis was performed to determine the gasdynamic disturbances in an engine inlet duct and at the compressor face that would result from a blast wave impinging on a moving aircraft. The dynamic wave system with accompanying overpressure and maximum distortion have been predicted. The basic study considers the shock wave strength modification due to capture area ratio, duct area change, and wave reflection at the compressor face. The results of this engine inlet analysis can be used as input into methods - e.g., dynamic engine simulation, for determining engine response to such noise. (Author)

A72-29578 Jet noise and sonic boom. M. J. Crocker (Purdue University, Lafayette, Ind.). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 480.

The introduction of the jet passenger aircraft twenty years ago and the rapid expansion in scheduled services has posed severe noise problems. These are community noise near the airports, aircraft cabin noise, and aircraft structural response and fatigue problems. Additional problems are connected with the introduction of supersonic jets. The sonic boom problem must be further studied so that the propagation of sonic booms in the atmosphere can be well understood. G.R.

A72-29579 Aircraft structural response and fatigue in a high-intensity noise environment. B. L. Clarkson. In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971.

Lafayette, Ind., Purdue University, 1972, p. 481-489.

30 refs.

The response of typical structures to jet noise is examined, giving attention to the response of stiffened plates and box-type structures. When a continuous structure, such as an aircraft fuselage or control surface, is excited by broad-frequency-band random forces the resulting vibration can be treated as the summation of responses in a relatively large number of modes. A simplified theory of response is discussed together with applications of the theory, test results, and aspects of fatigue. G.R.

A72-29581 Noise radiation from turbulent shear layer instability waves in supersonic jet exhausts. J. T. C. Liu (Brown University, Providence, R.I.). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 496-502. 27 refs.

In the surroundings of a perfectly expanded turbulent supersonic exhaust flow, optical observations at sufficiently large exit Mach numbers reveal a radiation field consisting of a collection of Mach waves. These are termed eddy-Mach waves by Phillips and eddy-supersonic bangs by Ffowcs Williams and Lighthill. The main contention in this paper is that the Mach wave radiation field is generated by supersonically traveling waves, rather than randomly occurring and disappearing eddies, which are inherent in the dynamically unstable supersonic turbulent free shear flow; certain observed symptoms appear to support this contention. The mechanisms which are responsible for the evolution of these waves in a developing turbulent free shear flow are discussed. The acoustic energy flux normal to the shear layer first increases and then decreases in the streamwise direction. (Author)

A72-29586 Maximum overpressures of sonic booms near the cusps of caustics. A. D. Pierce (MIT, Cambridge, Mass.). In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971.

Lafayette, Ind., Purdue University, 1972, p. 544-553.

27 refs.

Under certain circumstances, it is possible for a maneuvering supersonic aircraft to produce sonic booms with overpressures much larger than would be nominally expected. Such superbooms occur at points near those where the geometrical acoustics rays tend to focus. Linear acoustics allows the possibility of such focusing occurring along a surface in space known as a caustic. The generation of cusped caustics as a consequence of maneuvering or accelerating supersonic aircraft is discussed, and a simplified theory for the estimation of the peak overpressure at a caustic cusp is presented. G.R.

A72-29588 Bibliography on noise control. In: Noise and vibration control engineering; Proceedings of the Purdue Noise Control Conference, Lafayette, Ind., July 14-16, 1971. Lafayette, Ind., Purdue University, 1972, p. 559-581. 705 refs.

The references are mainly on acoustics and noise control. The references have been arranged under a number of headings, including surface transportation noise, machinery noise, industrial noise criteria and control, vibration control and biodynamics, legislation and city planning, noise in buildings, and noise instrumentation and measurement. The subject aircraft noise and vibration control has been subdivided into sections, such as general topics, jet noise, sonic boom, and turbulence noise. Compressor, fan and propeller noise is also considered. G.R.

A72-29622 * # A case study of persistent, intense, clear air turbulence in an upper level frontal zone. R. J. Reed (Washington, University, Seattle, Wash.) and K. R. Hardy (USAF, Cambridge Research Laboratories, Bedford, Mass.). *Journal of Applied Meteorology*, vol. 11, Apr. 1972, p. 541-549. 28 refs. NASA-supported research; NSF Grant No. GA-629X.

Widespread and persistent clear air turbulence (CAT) occurred over the Eastern Seaboard of the U.S. between New York and South Carolina on 18 March 1969. The major synoptic features and a qualitative discussion of the factors contributing to the development of the large vertical wind shears associated with the turbulence are presented. The turbulent region in the vicinity of Wallops Island, Va., was probed with a NASA T-33 research aircraft and with sensitive radars. The clear air radar echoes and the most intense turbulence occurred principally within an upper level frontal zone of about 2 km depth which was produced by the confluence of two currents of widely different origin. G.R.

A72-29639 # Stability of the boundary layer on a swept wing (Ustoichivost' pogrannichnogo sloia na skol'zishchem kryle). A. G. Volodin (Akademiia Nauk SSSR, Institut Teoreticheskoi i Prikladnoi Mekhaniki, Novosibirsk, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriya Tekhnicheskikh Nauk*, Oct. 1971, p. 3-5. 6 refs. In Russian.

Calculation of the velocity profile of an incompressible boundary layer on a swept wing. On the basis of a study of curves of critical Reynolds numbers obtained for a 45-deg angle between the wing chord and the streamline at the outer boundary of the boundary layer it is shown that for positive values of beta the minimum critical Reynolds numbers on a swept wing are lower than the corresponding values on a straight wing, while the reverse is true in the case of negative values of beta. A.B.K.

A72-29671 # Computation of unsteady forces on helicopter rotor blades (Calcul des forces aérodynamiques instantanées sur les pales d'un rotor d'hélicoptère). J.-J. Costes (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aéronautique*, Mar.-Apr. 1972, p. 91-106. 6 refs. In French.

Study of blades likened to thin lifting surfaces, using an integral equation which makes it possible to compute the velocity potential induced by a lifting surface element when its position, its orientation, and its lift are known as a function of time. The collocation method makes it possible to express the lift distribution as a function of the velocity component perpendicular to the blades on a network of collocation points distributed on the rotor disk. With this formulation it is possible to take full account of fluid compressibility. Application to a three-blade rotor, tested in a wind tunnel, made it possible to compare theory and experiment in forward flight. Agreement was reasonably satisfactory. F.R.L.

A72-29672 # Dynamically similar wind tunnel models for transonic aeroelastic studies (Maquettes de soufflerie dynamiquement semblables pour études aéroélastiques en transsonique). R. Destuynder and R. Labourdette (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *La Recherche Aéronautique*, Mar.-Apr. 1972, p. 107-112. In French.

Consideration of dynamically similar models which, in addition to their usefulness in establishing the dynamic stability of an aircraft, make possible experimental study of a certain number of failures or structural damages which cannot be simulated in the course of test flights. Examples are: loss of rigidity due to fatigue failure of lifting surfaces, engine failure, and failure of powered control surfaces. Such models are also useful to demonstrate safety margins against flutter in the transonic regime. F.R.L.

A72-29690 Dynamics of composite materials; Proceedings of the Joint National and Western Applied Mechanics Conference, La Jolla, Calif., June 26-28, 1972. Conference sponsored by the American Society of Mechanical Engineers. Edited by E. H. Lee (Stanford University, Stanford, Calif.). New York, American Society of Mechanical Engineers, 1972. 154 p. Members, \$9.60; non-members, \$12.

The papers deal with dynamic problems existing in the design and development of composite aircraft structures, stress-wave propagation and fracture in composites, the propagation of transient stress pulses in an obliquely laminated composite, and the directly reinforced composite as a homogeneous continuum with microstructure. A theory of interacting continua for wave propagation in composites is discussed, and variational methods for elastic wave propagation analysis in composites with periodic structures are surveyed. Randomness and wave propagation in inhomogeneous media are studied. F.R.L.

A72-29691 Dynamic problems existing in the design and development of composite aircraft structures. J. C. Halpin (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio) and M. E. Waddoups, Jr. (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). In: Dynamics of composite materials; Proceedings of the Joint National and Western Applied Mechanics Conference, La Jolla, Calif., June 26-28, 1972. New York, American Society of Mechanical Engineers, 1972, p. 1-7. 13 refs.

Development of an equation of state for unidirectional and laminated composites from the equations of state of their constituents in order to characterize materials of laminated anisotropic composites. Dynamic considerations for composite materials can be presented with respect to materials characterization and the dynamic response of composite structural components. F.R.L.

A72-29840 Digital data reduction methods for aircraft engine noise analysis. H. McNeill (Rensselaer Polytechnic Institute of Connecticut, Inc., Hartford, Conn.). *Sound and Vibration*, vol. 6, Apr. 1972, p. 26-29.

The employment of a digital computer to supplant the analog devices used for analyzing fan noise data has been made possible by the utilization of a generalized system of software programs which employ numerical techniques to achieve the analysis objective. The implementation of the fast Fourier transform algorithm permits significant speed-up in digital data processing with attendant cost reduction. The advantages of an employment of digital computers include reduced analysis time, lower cost, and improved information exchange resulting from the analytical technique standardization that is possible. The application of the digital data reduction method is shown in the analysis of a fan noise spectrum. G.R.

A72-29871 Bölkow 105C. *Flight International*, vol. 101, May 4, 1972, p. 637-642.

Description of a 5-place helicopter which displays a new approach to several fundamental rotorcraft problems. In maintenance, the philosophy is to 'remove and replace,' hence ease of access was built in. Maximum use is made of glass fiber for double-curvature panels. The two Allison turbine engines are mounted on the top decking behind the rotor pylon. They are inclined inward so their drive shafts can reach the common gear box. The rigid rotor blades are of glass-reinforced plastic, and offer a high degree of stability.

F.R.L.

A72-30011 # Diffraction of an acoustic wave at a moving or static plate (Difraktsiia akusticheskoi volny na dvizhushcheisia i nepodvizhnoi plastinke). E. A. Krasil'shchikova (Akademiia Nauk SSSR, Institut Problem Mekhaniki, Moscow, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 203, Mar. 11, 1972, p. 311-314. 8 refs. In Russian.

Analysis of the diffraction of a weak shock wave propagation in an infinite volume filled with an ideal gas and containing a plate. The shock wave front is a plane moving at the speed of sound. The plate moves rectilinearly at subsonic speed toward the shock wave at zero angle of attack, or is static and interacts with the oncoming wave. Integral equations proposed by the author (1952) in the slender wing theory are used to solve the involved diffraction problem.

V.Z.

A72-30025 # Evolution of structural systems and calculation conditions for aircraft landing gears (Evolutia sistemelor constructive si a conditiilor de calcul pentru trenul de aterizare al avioanelor). I. N. Iacovachi (Institutul pentru Creatie Stiintifica si Tehnica, Rumania). *Transporturi Auto, Navale si Aeriene*, vol. 2, Jan. 1972, p. 17-27. 24 refs. In Rumanian.

Discussion of the evolution of types of landing gears and the calculation conditions using various European and American regulations imposed by the stresses which occur during an aircraft landing. The purpose and operating conditions of a landing gear are reviewed, and the equations for the elastic system and the shock absorber are derived. Certain norms established in Italy, Great Britain, Germany, and the United States concerning the velocity of the impact occurring between the tires and the landing gear during landing are considered.

A.B.K.

A72-30037 Ultrasonic procedure for inspecting aluminum aircraft wheels. C. E. Guzi and J. W. Robertson (Procter and Gamble Co., Ivorydale Technical Center, Cincinnati, Ohio). *Materials Evaluation*, vol. 30, May 1972, p. 109-112.

The advantages of the ultrasonic inspection procedure are described. Previous methods, eddy current or fluorescent penetrant, required dismantling the wheel. It took 35 man-hours to perform the inspection. The new procedure requires 10 to 15 min and can be conducted while the wheels are on the aircraft. The sound is introduced through the wheel weight boss 90 deg to the direction the crack propagates. Cracks as small as 0.015 in. deep and 0.250 in. long can be detected.

G.R.

A72-30038 # High light transmission and electrically conducting film for windscreens. R. D. King (Triplex Safety Glass Co., Ltd., London, England). *Aircraft Engineering*, vol. 44, Apr. 1972, p. 16-18.

The physical properties of Hyviz laminate and gold film laminate developed for deicing the outer surface and demisting the inner surface of aircraft windshields are outlined and compared. The integrated visible light transmission of glass acrylic laminates with twin Hyviz and twin gold film heating is 77% and 57%, respectively.

Resistance and light transmission stability data are tabulated, together with the infrared reflecting properties of Hyviz.

V.P.

A72-30039 # HR 200 - Low cost series production. *Aircraft Engineering*, vol. 44, Apr. 1972, p. 20-23.

The materials and operations involved in the serial production of the HR 200 training and acrobatic two seater low-wing metal aircraft developed by Avions Pierre Robin are examined. The external and internal dimensions and the performances at maximum takeoff weight are specified. Series production is expected to start in October, 1972, at a rate of two a week.

V.P.

A72-30040 # The effect of lightning on materials. J. D. Ibbott (Electrical Research Association, Leatherhead, Surrey, England). *Aircraft Engineering*, vol. 44, Apr. 1972, p. 25-28. 16 refs.

Available data on the effects of lightning on metallic, non-conducting (glass-fiber reinforced plastics), and semiconducting (carbon-fiber-reinforced plastics) aircraft constructional materials are reviewed. Simulated lightning current tests are described, and the test results are examined. To assess the relevance of the test currents employed, the current characteristics of lightning discharges are outlined.

V.P.

A72-30041 # Decision diagram approach to 'on condition' philosophies. F. S. Nowlan (United Air Lines, Inc., Chicago, Ill.). *Aircraft Engineering*, vol. 44, Apr. 1972, p. 35-37.

The use of decision diagrams in logic analysis for testing the validity of maintenance program decisions is discussed. The potential effectiveness of scheduled maintenance tasks relative to the control of operational reliability is assessed. The analysis indicates why specific tasks should or should not be scheduled.

V.P.

A72-30076 # The potential of the VSTOL airliner. J. Spintzyk. *Dornier-Post* (English Edition), no. 2, 1972, p. 3-6.

Evaluation of the advantages held out by V/STOL aircraft for civil air traffic, and of the market which can be expected. The advantages are the considerable cuts in point-to-point travelling time, low land demand, adaptability to traffic demands, and low initiation and total investment costs, especially in comparison with advanced ground transport media requiring the preparation of new road and rail systems. It is suggested that 700 aircraft, carrying 80 to 100 passengers over a range of 800 km at a speed of 740 km/hr, will be needed by 1985.

F.R.L.

A72-30077 # Alpha jet wind tunnel tests. P. Esch and J. von der Decken. *Dornier-Post* (English Edition), no. 2, 1972, p. 7-10.

Review of the wind tunnel tests carried out on the twin-engine trainer developed by the Dassault-Breguet and Dornier group. Twelve models were tested in ten different wind tunnels. A very important series of tests is devoted to the possibility of induced oscillations occurring in the wing or the empennage. A flutter analysis, designed to uncover any possible causes of the phenomenon, is outlined.

F.R.L.

A72-30078 # The operational potential of the Kiebitz system. *Dornier-Post* (English Edition), no. 2, 1972, p. 15, 16.

Discussion of a tethered autostabilized rotor platform intended to improve reconnaissance performance. The pneumatically powered two-blade rotor is a more powerful version of the rotor which has been proven in the experimental Kiebitz equipment. The tethering

cable contains, in addition to the fuel hose, two coaxial cables and 72 separate lines. The range of possible applications covers surveillance, target location, and communications. F.R.L.

A72-30097 **A rescue hoist for the light transport helicopter Bell UH 1-D (Eine Rettungswinde für den leichten Transporthubschrauber Bell UH 1-D).** K. Göwecke. *AEG-Telefunken, Technische Mitteilungen*, vol. 62, no. 2, 1972, p. 54-56. In German.

Description of a new electrically driven, internally mounted helicopter hoist that has been developed specifically for rescue operations under special conditions. Detailed attention is given to the hoist structural design and the electrical drive mechanism. Technical data are presented. O.H.

A72-30098 **Aircraft tyres - An analysis of performance and development criteria for the 70s.** R. G. Clifton and J. L. Leonard (Dunlop Co., Ltd., Foleshill, Coventry, England). *Aeronautical Journal*, vol. 76, Apr. 1972, p. 195-216.

Trends in tire shapes are discussed, taking into account tire load, inflation pressure, and aspects of undercarriage geometry. Tire environmental operating conditions are examined, and attention is given to VTOL operations, aspects of braking, and Concorde operating conditions. It is pointed out that aircraft tires are expected to function satisfactorily at extremely low temperatures. Qualification tests are an essential part of the development and acceptance of new aircraft applications. Contact pressure distribution and its relation to tread wear are considered together with the rolling tire, coupled or twin-tired wheels, the radial casing tire, the radial ply tire, and a new dynamometer. G.R.

A72-30119 # **Improvement of design solutions for domestic airport runway lighting systems (Imbunatatirea solutiilor din proiectare pentru sistemele de balizaj luminos ale pistelor de la aeroporturile interne).** A. Lebadă (Institutul de Proiectări Transporturi Auto, Navale și Aeriene, Rumania). *Transporturi Auto, Navale și Aeriene*, vol. 2, Feb. 1972, p. 77, 78. In Rumanian.

Brief review of the development of runway lighting systems for use at domestic airports in Rumania. A description is given of a low-intensity lighting system built some years ago, an improved lamp to be used with this system to make possible night flights, and a new improved lighting system with a range of 900 m. In addition, brief mention is made of a newly developed control console. A.B.K.

A72-30125 **How many aircraft.** A. P. Ellison (Queen Mary College, London, England). *Shell Aviation News*, no. 405, 1972, p. 6-9.

Proposal of some guidelines to the forecasting of airline aircraft demand. Improved data are essential if mathematical models are to be effectively tested and evaluated. Detailed histories of existing aircraft are, to the forecaster of aircraft orders, an essential supplement to the ICAO figures. It is shown that the use of stock measures of registrations leads to inaccurate measures of permanent 'departures' from the list and possibly to inaccurate forecasts of replacement demand. F.R.L.

A72-30276 # **Aspects taken into account at the Aviation Institute for Research and Testing in life fatigue tests (Aspekty sledovane ve VZLU pri prukazech unavove zivotnosti).** J. Bocan, O. Cais, and Z. Klima. *Zpravodaj VZLU*, no. 1, 1972, p. 7-26. 48 refs. In Czech.

Discussion of experimental fatigue life testing of airframes. The various aspects that have to be taken into consideration when conducting fatigue life tests are reviewed. As an example, a description of a fatigue life test of a wing is presented. A recomputation of experimental results for the case of changed operating conditions is briefly outlined. Finally, detailed characteristics of fatigue life tests are given, and the residual fatigue life of aircraft is examined. O.H.

A72-30277 # **Residual fatigue tests of a welded airframe by nonstationary random loading (Rezidualni unavove zkousky svarovane konstrukcni casti nestacionarnim nahodnym zatizenim).** J. Drexler and V. Nejedlý. *Zpravodaj VZLU*, no. 1, 1972, p. 27-39. 12 refs. In Czech.

Summary of some principal theoretical and experimental investigations concerning the problems of the fatigue life of airframes that have been obtained in recent years at the Aviation Institute for Research and Testing. Emphasis is placed on residual fatigue tests of welded steel airframes. A typical welded section of the landing gear of a jet trainer aircraft is described, and mechanical stresses occurring in this section are defined. Results obtained from different fatigue life tests are presented. Finally, a method of analysis of the fatigue damage mechanism, based on the black box concept, is discussed. O.H.

A72-30279 # **Small-cycle fatigue of aircraft jet engine components during nonstationary temperature conditions (Malocyklova unava soucasti leteckych turbinovych motoru pri nestacionarnich teplotnich podminkach).** J. Statečný. *Zpravodaj VZLU*, no. 1, 1972, p. 45-55. 25 refs. In Czech.

The approach for determining the necessary lifetime of jet engine components under conditions of cyclic operation is discussed. Typical means for this analysis are examined. They include the determination of the component temperature field, stress and strain determination in the critical spot, a lifetime calculation based on material fatigue curves, and experimental assessment of the lifetime. The effect of the material and operational factor is also considered. O.H.

A72-30281 # **Reliability of the training cockpit TL-29 (Spolehlivost pilotni cvicne kabiny TL-29).** V. Vek. *Zpravodaj VZLU*, no. 1, 1972, p. 65-70. In Czech.

The mean time of failure-free operation of the training cockpit PL-29 has been calculated, and the results are tabulated. Reliability measurements during development tests and during the two years' guarantee are described. Data are presented that yield the basis for the reliability calculation of aviation electronic devices. O.H.

A72-30282 # **Aircraft gust-load spectra at low altitudes above the territory of the CSSR (Spektra zatizeni letadel od poryvu v malých výškách nad územím CSSR).** M. Kucera. *Zpravodaj VZLU*, no. 2, 1972, p. 3-13. 7 refs. In Czech.

Aircraft gust-load spectra have been obtained for small aircraft and interpreted in terms of cumulative frequencies of equivalent gust velocities. They are arranged as partial spectra that make it possible to combine operational conditions and to derive the overall spectrum for a given aircraft. In classifying the spectra, the effect of the development of turbulent conditions was taken into account. The classification criteria were aircraft categories, flight altitudes, time of day, wind velocity, etc. Analytical expressions were derived for typical gust spectra. Using this analysis, a quantitative assessment of the effect of a short distance from the earth on the increased frequency of gust-loading of aircraft can be made. O.H.

A72-30283 # Ground loading in the stress spectrum of aircraft structures (Pozemní zatížení ve spektru namáhání leteckých konstrukcí). J. Sprino. *Zpravodaj VZLU*, no. 2, 1972, p. 15-23. 8 refs. In Czech.

Current stress calculations and design data for aircraft landing gears are presented. A linearized theory for a model investigation of landing gears is explained, and its application to calculations of stresses occurring on airport runways is discussed. It is shown that using this theory, some cases of extreme stresses can be interpreted. Some practical results of recent research and development activities in the field of determining and suppressing stresses of this type are presented. O.H.

A72-30284 # Determination of flow characteristics on horizontal tail surfaces for the calculation of their stresses during the flight in a turbulent atmosphere (Určení charakteristik proudění v místě VOP pro výpočet jejich zatížení při letu v turbulentní atmosféře). V. Kocka and V. Tichopad. *Zpravodaj VZLU*, no. 2, 1972, p. 25-37. 17 refs. In Czech.

Downwash angle measurements have been carried out during both rectilinear steady motions and unsteady motions on a small transport airplane to obtain data necessary for calculating the stresses occurring at horizontal tail surfaces and the lifetime of these surfaces. Identification methods and statistical significance tests were used to consider the suitability of the suggested and employed mathematical models. In addition, a theoretical analysis has been made of the effect of Strouhal's number during lower flight velocities. O.H.

A72-30285 # Effect of environment and operational reliability of structures (Vliv prostředí a provozní spolehlivost konstrukcí). J. Novak. *Zpravodaj VZLU*, no. 2, 1972, p. 39-42. In Czech.

Major effect of environment on structures, and problems of structural protection are discussed. Examples of failures during operation and methods for their removal are given. Finally, problems of the lifetime of protective coatings are examined. O.H.

A72-30286 # Effect of modern measuring technique on the development of experimental works at the Aviation Institute for Research and Testing (Vliv moderní měřicí techniky na rozvoj experimentálních prací ve VZLU). J. Cernohorsky. *Zpravodaj VZLU*, no. 2, 1972, p. 43-48. In Czech.

The importance of measuring technique for the current research and development of aircraft is emphasized and future trends in this field are outlined. Main attention is given to three major topics: quartz tensometers and their applications in scanners of mechanical factors; digital centrals for measuring a large number of small measuring signals; and a system for digital processing temporarily variable sequences of measuring signals. O.H.

A72-30288 # Contribution of computers to the solution of operational reliability and fatigue life problems of aircraft structures (Prínos počítačů k řešení problému provozní spolehlivosti u navoňe životnosti letadlových konstrukcí). O. Kropac. *Zpravodaj VZLU*, no. 2, 1972, p. 55-64. In Czech.

A general characteristic is first outlined of reliability and fatigue problems occurring in aviation. A description is then given of the algorithms and programs developed to solve these problems; some typical examples are presented. Finally, some novel possibilities for the application of computers to the solution of fatigue life and operational reliability problems are suggested. O.H.

A72-30289 Linear flap-lag dynamics of hingeless helicopter rotor blades in hover. R. A. Ormiston and D. H. Hodges (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.). *American Helicopter Society, Journal*, vol. 17, Apr. 1972, p. 2-14. 7 refs.

The linear stability characteristics of rotor blade flap-lag oscillations in the hovering flight condition are examined. The present study is focused on the effects of pre-cone, variable elastic coupling, pitch-lag coupling, and the aerodynamics of induced inflow. Together with an improved perturbation analysis for deriving the equations these factors are shown to significantly influence the flap-lag stability characteristics of hingeless rotor blades. Routh's criteria are used to derive several fundamental flap-lag stability relations, and emphasize the utility of simplified rotor blade modeling for understanding complex dynamic phenomena. In order to validate the approximate rigid blade equations, elastic blade modal equations are presented together with comparative solutions. The results indicate a high degree of accuracy for the approximate equations when the elastic coupling is included. Finally, the approximate equations are used to illustrate the influence of elastic coupling on the response characteristics of hingeless rotors. (Author)

A72-30290 The Rostrum. B. Lindenbaum (Hughes Tool Co., Culver City, Calif.). *American Helicopter Society, Journal*, vol. 17, Apr. 1972, p. 67, 68.

A new tail rotor blade has been developed for the Hughes 500 and OH-6 series helicopters. This is a fully cambered airfoil which retains excellent stall characteristics at the high Mach numbers normally associated with tail rotors. An initial static thrust comparison between the standard OH-6A tail rotor with symmetrical blades and a tail rotor fitted with the new cambered blades indicated an increase in maximum thrust capability of 40 to 50% at the same maximum power. G.R.

A72-30300 # Aircraft measurements of the atmospheric mesoscales using an inertial reference system. D. K. Lilly and D. H. Lenschow (National Center for Atmospheric Research, Boulder, Colo.). (Symposium on Flow, Pittsburgh, Pa., May 10-14, 1971.) *Facilities for Atmospheric Research*, Dec. 1971, p. 2-8. 9 refs.

Some important meteorological phenomena associated with the various horizontal scale ranges are shown together with some current techniques and instrumentation used to make quantitative measurements of the horizontal and vertical motions on these scales. It is indicated that aircraft equipped with inertial platforms and other instrumentation are capable of making flow measurements on the mesoscale. The current state of development and utilization of such aircraft-motion field sensing systems is described, and some examples of atmospheric flow measurements are discussed. G.R.

A72-30326 Determination of natural oscillations from an oscillation test in an exciter configuration (Zur Ermittlung der Eigenschwingungsgrößen aus einem Schwingungsversuch in einer Erregerkonfiguration). H. G. Natke (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Zeitschrift für Flugwissenschaften*, vol. 20, Apr. 1972, p. 129-136. 11 refs. In German.

Discussing first the characteristics of conventional ground vibration test methods, the author then defines the requirements to be fulfilled by modern ground vibration test methods on the basis of the experience gained with the classic technique in the course of tests on, for instance, the Europa I third stage including payload. The author briefly explains a method to compute the natural oscillation magnitudes from the measured dynamic response of the system by harmonic excitation in one exciter configuration, giving examples to illustrate its application. The first example considers a ground vibration test on a helicopter, where in-phase excitation in the

considered degrees of freedom was made impossible by the inaccessibility of the structure as concerns excitation. The second example deals with the separation of three superposed degrees of freedom of a transport aircraft. (Author)

A72-30365 Wing-body interaction in supersonic flow past dihedral wings. R. T. Waechter (Melbourne, University, Melbourne, Australia). *Mathematika*, vol. 18, Dec. 1971, p. 188-195. 9 refs. Research supported by the Ministry of Technology.

The problem of the initial structure of wing-body interaction for supersonic leading edges is formulated. It is assumed that the wing lies approximately in a plane parallel to the axial plane of a nonlifting cylindrical body with circular cross section. The main result of the formulation is the determination of the first two terms of the expansion of the velocity potential on the root chord. Numerical tabulation shows the second term coefficients. The angle between the plane of the wing and of the body surface is constant, but may assume values from zero to 180 deg. The results are also applicable to the case in which the angle varies with distance downstream of the start of the interaction. Here the leading term of the velocity potential on the root chord may be modified by using the slender body approximation. D.F.L.

A72-30422 Electro-RAM - A new actuator concept for fly-by-wire. R. H. Mitchell and R. L. Warren (LTV ElectroSystems, Inc., Dallas, Tex.). *Signal*, vol. 26, June 1972, p. 65-67.

Description of the Electro-RAM (Electromechanical Redundant Actuating Mechanism) to be flown as a driver for the dual-tandem hydraulic power servo that positions the stabilator of the F-4 aircraft. The power servo, the Survival Stabilator Actuator Package (SSAP), develops its own hydraulic power locally from two electrically driven hydraulic pumps integrated into the actuator. The four channels of Electro-RAM are continuously monitored, resulting in two-fail-operate performance. The monitoring is done by comparison of tachometer signals from the motors. Electro-RAM offers the system designer a way of combining his redundant control system channels where he needs a single output. F.R.L.

A72-30425 Downwash - The dangers and defense. W. P. Schane (U.S. Army, Aeromedical Research Laboratory, Fort Rucker, Ala.). *VertiFlite*, vol. 18, May-June 1972, p. 6-8.

Consideration of the effects of downwash velocities under rotary-wing and other VTOL aircraft, with a view to preventing incapacitating injuries. Eye protection with goggles is essential in winds above 15 kt. Working in downwash can be very fatiguing, and gusty winds can disturb equilibrium beyond the point of recovery. Extreme caution must be exercised when helicopters are operated close to loose and potentially freely flying objects on the ground. F.R.L.

A72-30429 # Determination of the lifetime of a structural element on the basis of certain concepts on the mechanism of fatigue failure (Opredelenie dolgovechnosti konstruktivnogo elementa na osnove nekotorykh predstavlenii o mekhanizme ustalostnogo razrusheniia). A. S. Mostovoi, A. A. Kozlov, L. K. Frolova, and A. A. Churakov (Kuibyshevskii Aviatsionnyi Institut, Kuibyshev, Ukrainian SSR). *Problemy Prochnosti*, vol. 4, Mar. 1972, p. 21-27. 6 refs. In Russian.

A method for calculating the fatigue strength of an aircraft element prepared from 1Kh18N10T (nickel-chromium-titanium) steel is proposed. The mechanism of fatigue failure is described by an integral equation with respect to derivatives inverse to the crack propagation rates along the selected coordinates. Integration of the derivatives obtained yields the crack propagation time. Fatigue strengths calculated for harmonic and programmed loads are verified experimentally. V.P.

A72-30446 # Noise of flying aircraft and a subjective estimation of its disturbing effect (Proletnyi shum samoletov i sub'ektivnaia otsenka ego bespokoiashchego deistviia). M. I. Nekipelov (Irkutskii Gosudarstvennyi Meditsinskii Institut, Irkutsk, USSR). *Akusticheskii Zhurnal*, vol. 18, Jan.-Mar. 1972, p. 74-81. 18 refs. In Russian.

Description of noise measuring equipment which was used at the Irkutsk airport and in nearby areas to determine aircraft noise at different distances from the landing strip for its assessment as a public nuisance. The equipment operated at 45 Hz through 11.2 kHz and included a microphone, a noise measurer, a recorder, a magnetophone, and a 45 Hz to 23 kHz spectrometer. Noise data were collected for 1500 flights of Tu-104 turboprops and from questionnaires passed over to 2260 local residents. The spectral changes in aircraft noise were found to be consistent with the Doppler effect. Combinations of various factors influencing the reactions of local residents to noise are discussed. V.Z.

A72-30581 # Simplified dynamic model of a gas turbine with an isolated turbocompressor (Uproshchennaia dinamicheskaia model' GTU s vydelennym turbokompessorom). V. B. Frumkin. *Energomashinostroenie*, vol. 18, Feb. 1972, p. 30-32. In Russian.

A linear mathematical model is developed for a twin-shaft gas turbine with an isolated turbocompressor. Formulas for calculating the dynamic constants as a function of the modes of turbine operation are proposed. V.P.

A72-30621 Airport lighting and power supplies - The final landing aid. *Interavia*, vol. 27, May 1972, p. 499-501.

Discussion of the external visual aids necessary to complete a landing in Category I, II, or III conditions. Typical lighting installations are described. These make use of visual slope indicators, runway centerline lights, and various approach lighting layouts to aid the pilot in determining position and altitude. A typical basic power equipment layout as proposed by GEC for a two-runway airport is described. Major airports require power of the order of several thousands of kilowatts for efficient operation, and individual loads are usually dispersed over wide areas. F.R.L.

A72-30678 Test - MBB Bo 105. H. C. Rosenberg. *Flug Revue/Flugwelt International*, May 1972, p. 56-61. In German.

A test report is presented of Messerschmitt-Bölkow-Blohm's Bo 105, a five/six-seat light utility helicopter. The aircraft has a four-blade main rotor of rigid unarticulated type with folding glass-fiber reinforced plastic blades, titanium rotor hub, and two-blade semirigid tail rotor with blades of glass-fiber reinforced plastics. The fuselage is of conventional light-alloy structure with a glass-fiber reinforced cowl over the power plant. O.H.

A72-30679 VFW-Fokker VFW 614 flight test program (Flugerprobung VFW-Fokker VFW 614). W. H. W. Issel (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Flug Revue/Flugwelt International*, May 1972, p. 83-86, 95-98. In German.

The VFW-Fokker's VFW 614 flight test activity up to the present state is dealt with in detail. After covering the tasks of flight test programs in general, the preparations of a flight test program are outlined, and the flight test equipment is described in detail. A detailed description of the VFW 614 flying prototype is also given, and features of the test program which it will undergo are shown. Finally, flight-test timing is discussed, and an outlook on future flight testing is briefly given. O.H.

A72-30721 # A method of pilot transfer function identification suitable for adaptive control using analog/hybrid computer. T. Tsumura (Osaka Prefecture, University, Sakai, Osaka, Japan) and M. Kajita. *Osaka Prefecture, University, Bulletin, Series A - Engineering and Natural Sciences*, vol. 20, no. 1, 1971, p. 89-95. 9 refs.

A new method is proposed which can quickly identify the incrementally changing transfer function when operating a pilot trainer. The method requires an iterative-type differential analyzer or an analog-hybrid computer; no digital computer or digital data processor is needed. An actual circuit configuration for obtaining the pilot transfer function of an experimental man-machine system is presented. Experimental results show that the proposed method is valuable for man-machine systems and on-line adaptive control systems. O.H.

A72-30776 Aircraft detail design manual /2nd edition/. S. J. Dzik. Milwaukee, Aviation Publications, 1971. 170 p. \$6.95.

Numerous detail design illustrations are presented in 3-view and perspective form, and definitions applicable to wing design are given. Laminar flow or low drag airfoil sections, and precautions to be taken with laminar flow airfoils are considered. The latter involve suction airfoils, the effect of yaw or sweepback, and the effect of small aspect ratio. The characteristics of plain, split, slotted, and multiple flaps are described. Brief comment is made on the compressed air flap. F.R.L.

A72-30813 # Airbus - The aircraft of the near future. I (Airbus - Das Flugzeug der nächsten Zukunft. I). W. Scheinin. *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 3, 1972, p. 108-114. In German.

An airbus is a passenger aircraft for short and intermediate routes with the capacity to carry a great number of passengers. The main problems in the design of airbuses are examined, giving attention to the number of passengers, the operational range, the number and the location of the propulsion units, and the dimensions and the form of the fuselage. The design characteristics of aircraft types of the three jet aircraft generations are discussed. G.R.

A72-30814 # The angle of inclination of the glide path. III (Der Neigungswinkel des Gleitweges. III). S. L. Belogorodskii (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR). (*Grazhdanskaia Aviatsiia*, no. 12, 1971.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 3, 1972, p. 115-121; Discussion, p. 121, 122. In German. (Translation).

The optimal angles of inclination for the glide path in the case of modern civil aircraft are in the range from 2.5 to 3 degrees. The vertical velocity, the operation of the propulsion units, and aspects of the landing procedure are taken into account in the selection of the optimal angles. A value of 2 degrees and 40 minutes is recommended for the angle of inclination of the glide path on the basis of the practical experience obtained in the USSR. A schematic presentation of the glide path is shown and the various parameters involved in the selection of the angle of inclination are analyzed. G.R.

A72-30815 # About the role of the copilot in the implementation of the flight mission (Über die Rolle des 2. Piloten bei der Durchführung des Flugauftrages). W. Denisow, D. Glushchenko, and P. Klimenko. (*Grazhdanskaia Aviatsiia*, no. 11, 1971.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 3, 1972, p. 123-125. In German. (Translation).

The minister of civil aviation in the USSR has emphasized the necessity to enhance the importance of the copilot in the crew and to make the copilot an active assistant of the pilot particularly during the takeoff and the landing phases. Approaches for achieving this objective are investigated, taking into account an evaluation of the professional abilities of the copilot. The performance of the copilot and of the pilot in a number of situations is compared. G.R.

A72-30817 # Aeromechanical analysis of various flight attitudes of conventional aircraft. II - Mechanical fundamentals /dynamics of the point mass/ (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. II - Mechanische Grundlagen /Dynamik der Punktmasse/). F. Seidler (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 3, 1972, p. 135-147. In German.

The most significant relations concerning forces are considered, giving attention to the force concept, the principle of action and reaction, aspects of inertia, and the composition of forces. Newton's laws and their significance are considered, taking into account various units used for the force parameter. Symbols and indices used are listed in a table. G.R.

A72-30818 # State of development and employment possibilities of hovercraft. II (Entwicklungsstand und Einsatzmöglichkeiten des Luftkissenschiffes. II). S. Knöfel. *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 1, 1972, p. 8-14. In German.

Characteristic performance criteria for hovercraft are discussed, giving attention to a comparison of this vehicle with other means of transportation. The hovercraft has been used as a means of transportation since 1962. Conditions which are favorable for an economic employment of hovercraft in preference to other means of transportation are cited. Possibilities for the use of hovercraft in the German Democratic Republic are discussed together with general prospects for the application of the hovercraft principle. The applications considered include a vehicle for agricultural employment and vehicles for the transportation of very heavy industrial equipment. G.R.

A72-30820 # Minima for the landing of aircraft (Minima für die Landung von Luftfahrzeugen). S. L. Belogorodskii (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskoi Aviatsii, Moscow, USSR). (*Grazhdanskaia Aviatsiia*, no. 10, 1971.) *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 1, 1972, p. 23, 24, 29-31. In German. (Translation).

The operational flight regulations of civil aviation of the USSR contain new rules regarding the minima for the takeoff and landing of aircraft. Minimum values with regard to the altitude of the lower cloud limit for the landing of aircraft and helicopters are considered together with the minimum range of horizontal visibility which guarantees the safe landing of an aircraft. The magnitude of the minimum values for an aircraft type depends on its aerodynamic characteristics and its equipment. Airport characteristics and the professional qualifications of the pilot are also significant. A new definition for the decision height is also considered. G.R.

A72-30822 # Problems of personnel planning in the field of aircraft maintenance (Probleme der Arbeitskräfteplanung im Bereich Flugzeuginstandhaltung). P. Bork and R. Wollschläger (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 1, 1972, p. 34-45. In German.

Questions regarding the planning of different types of maintenance work are discussed together with the relations between maintenance personnel and the time required for the maintenance of the aircraft. A formula is presented for computing the number of flying hours on the basis of various parameters connected with the maintenance operations. Questions of economics are taken into account in deriving optimal maintenance conditions for an aircraft including the employment of the required maintenance personnel.

G.R.

A72-30823 # Problems at the introduction of electronic data processing into the procedure for the material-technical supply of Interflug and approaches to solve them. I (Probleme und Lösungswege bei der Einführung der EDV für den Prozess der materiell-technischen Versorgung der Interflug. I). R. Drömer, H. Witzke, R. Sluda, and U. Schwemmin (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 8, no. 1, 1972, p. 46-52. In German.

The application of the methods of electronic data processing is to increase the efficiency of the procedures concerned with the maintenance of aircraft and auxiliary equipment. The various processes in the system of material-technical supply are examined together with the factors which have to be taken into consideration during the first phase of the introduction of electronic data processing. Attention is given to basic data, data regarding the material, questions concerning the prediction of material requirements, and aspects of receiving and routing the material.

G.R.

A72-30830 # Operational analysis of hypersonic commercial aircraft. C. R. Sturdevant (Douglas Aircraft Co., Long Beach, Calif.). *Operations Research Society of America, National Meeting, 41st, New Orleans, La., Apr. 26-28, 1972, Paper. 8 p.*

A projection of historical passenger aircraft speeds versus time, to the year 2000 A.D., indicates Mach 10 speeds (6,000 mph) should be technologically feasible. However, the value of developing a Mach 10 hypersonic transport (HST) aircraft must first consider the operational problems introduced by very high design speeds. These include passenger physiology limits; the ability to convert increased design cruise speeds to: (1) higher average trip speeds, (2) appropriate reductions in trip time, and (3) appropriate increases in aircraft productivity; and potential logistics requirements. In addition, HST economic worth, and a definition of the design requirements for operationally suitable aircraft, must consider airline applications analyses, route structure, route passenger traffic demands, ground turnaround time capability, flight frequencies necessary for competitive service, and numbers of aircraft required over which to amortize the development costs.

(Author)

A72-30841 On an exact solution, with critical point, of hodographic equations for plane flow of a compressible fluid (Sur une solution exacte, avec point critique, des équations de l'hodographe pour l'écoulement plan d'un fluide compressible). R. Legendre (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Académie des Sciences (Paris), Comptes Rendus, Serie A - Sciences Mathématiques*, vol. 274, no 2, Jan. 10, 1972, p. 208-210. In French.

Attempt to obtain exact analytic solutions of hodographic equations, few of which are known, and none of which comprise the critical points which appear during the application to the calculation of airfoil sections or turbine engine cascades. The discretization necessary for solution of the integral equation of the problem is reduced to use of limited Fourier series.

F.R.L.

A72-30844 Simulators of aircraft and ground vehicles - Evolution of needs and techniques (Simulateurs d'aéronefs et de véhicules terrestres - Evolution des besoins et des techniques). R. Pagel (Matériel Téléphonique, Montrouge, Hauts-de-Seine, France). *L'Onde Electrique*, vol. 52, Apr. 1972, p. 165-173. In French.

Some of the characteristics of aircraft and other vehicle simulators used for training crews are discussed with special emphasis on ongoing changes in needs and techniques. It is shown that the advent of digital techniques in the field of simulation in 1964 has made it possible to broaden the application range and to improve the performance capabilities of simulators as compared to those achievable with analog techniques. Present development efforts are directed at simulation realism enhancement in terms of visual and physiological experiences.

M.V.E.

A72-30845 Simulators of aircraft and ground vehicles - Description of the simulators (Simulateurs d'aéronefs et de véhicules terrestres - Description de simulateurs). J. Baradat (Matériel Téléphonique, Boulogne-Billancourt, Hauts-de-Seine, France). *L'Onde Electrique*, vol. 52, Apr. 1972, p. 174-178. In French.

Some of the main features of simulators are discussed, and their principal components are considered. In particular, their control-load, visual-attachment, cabin-motion, and sound subsystems are reviewed. The range of variation in the requirements and designs of these subsystems is illustrated by the presented descriptions of three simulators of a medium-range twin-turboprop transport aircraft, a 2500-kg-payload 300-km/hr helicopter, and an all-terrain ground vehicle, respectively. Some of the major design problems are pointed out and briefly discussed.

M.V.E.

A72-30860 # Navy aircraft program in advanced composites. A. Manno (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). *American Society of Mechanical Engineers, Design Engineering Conference and Show, Chicago, Ill., May 8-11, 1972, Paper 72-DE-3. 8 p. 5 refs. Members, \$1.00; nonmembers, \$3.00.*

Description of the composites structural program undertaken by the Navy and intended to develop the technology needed to incorporate composite structure on future aircraft. The composites are shown to have significant advantages such as weight savings, extended life, and corrosion resistance, which are factors that contribute toward increasing the performance, reliability, and maintainability of aircraft. Design concepts are shown, and cost considerations are discussed. Examples of applications which are cost competitive with metal counterparts are given. Finally, additional work that has to be done to employ composites in future aircraft is outlined.

O.H.

A72-30867 # Nondestructive testing of coalescers /fuel filters/ on a continuous basis using liquid crystals. A. P. Pontello (U.S. Naval Air Propulsion Test Center, Philadelphia, Pa.). *American Society of Mechanical Engineers, Design Engineering Conference and Show, Chicago, Ill., May 8-11, 1972, Paper 72-DE-25. 7 p. Members, \$1.00; nonmembers, \$3.00.*

A nondestructive test for 100 per cent inspection of coalescer elements (fuel filters) has been developed using liquid crystals as the flaw-detecting agent. Thermal changes associated with material defects are detected by the liquid crystals through a pattern of vivid colors encircling the defect. Liquid crystals can detect flaws in coalescer elements in the form of voids, split seams, end cap leaks and cracks, material imperfections and epoxy filled voids. (Author)

A72-30907 A photothermoelastic investigation of transient thermal stresses in wing ribs. E. Matsumoto, T. Sekiya (Osaka

Prefecture, University, Osaka, Japan), and S. Sumi (Kyushu University, Fukuoka, Japan). *Journal of Strain Analysis*, vol. 7, Apr. 1972, p. 117-124. 10 refs. Research supported by the Matsunaga Science Foundation.

The photothermoelastic method of refrigeration has been used to study the problem of a long beam under transient temperature distribution and good correlation with the theoretical values has been obtained. The new technique for three-dimensional photothermoelasticity, which uses a composite model made of photoelastically sensitive and insensitive materials, is suggested for the analysis of idealized wing-rib structures. (Author)

A72-30944 **Microwave model of an instrument-landing-system glidepath.** J. G. Lucas (Sydney, University, Sydney, Australia). *Institution of Electrical Engineers, Proceedings*, vol. 119, May 1972, p. 529-536. 8 refs. Research supported by the Department of Civil Aviation of Australia.

A 1/30th scale model of the international standard instrument-landing-system glidepath is described. Interference effects on the linearity of the path in space are investigated, and a theoretical analysis is applied which confirms the integrity of the model operation. The effects due to aircraft taxiing in typical airport regions have been measured using accurate scale models of common civil aircraft. From the results obtained, it is expected that an appreciation of critical areas for air-field taxiway movements will be obtained. G.R.

A72-30949 # **Laminar boundary layer developed on a semi-infinite flat plate in oscillations in a uniform flow (Couche limite laminaire développée sur une plaque plane semi-infinie en oscillations dans un écoulement uniforme).** E. Perez. Aix-Marseille, Université, Faculté des Sciences, Doctorat de Spécialité Thesis, 1972. 84 p. 10 refs. In French.

Analysis of the influence of vibrations of an airfoil section on its drag. For this purpose it is necessary to determine, in the first place, the velocity profile in the boundary layer developed on a semiinfinite flat plate in harmonic oscillations parallel to a current of incompressible fluid of velocity U sub o . Previous studies have been made on a fixed flat plate placed in a flow of incompressible fluid with a modulated velocity of a certain form. A theory is developed based on an extension to the unsteady case of the classical method developed by Germain (1962) for study of the laminar boundary layer on a flat plate fixed in a uniform current. F.R.L.

A72-30950 # **Contribution to the study of the flow in the vicinity of rotor blade extremities (Contribution à l'étude de l'écoulement au voisinage de l'extrémité des pales d'un rotor).** N. D. Thinh. Lyon, Université, Faculté des Sciences, Dr.-Ing. Thesis, 1971. 153 p. 32 refs. In French. Research supported by the Electricité de France.

Study of the flow at rotor extremities, where it is strongly three-dimensional, and where the effects of the law of circulation combined with those of the boundary layers cannot be neglected, especially if the latter are thick. In these wall zones, the 'energy losses' along the lines of current become more important and depend largely on the configuration of the flow. An experimental study was carried out on a free vortex type rotor for which the circulation remains constant along the length of the span of the blade. Measurements of velocity, of intensity of turbulence pressure, and of Reynolds tension made at different sections and at different operational regimes show how, downstream of the rotor, the flow evolves so as to reach a state of equilibrium. The results of the measurements are related to those obtained in a simple aerodynamic model which could serve toward understanding of the secondary effects downstream of the rotor. F.R.L.

A72-31022 # **Experimental determination of the pressure distribution over a triangular wing with blunted edges at small angles of attack (Eksperimental'noe issledovanie raspredeleniia davleniia na treugol'nom kryle s prituplennymi kromkami pri malykh uglakh ataki).** V. V. Ivanov and A. V. Krasil'nikov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Mar.-Apr. 1972, p. 166-169. 8 refs. In Russian.

A delta-wing model with blunt edges and an apex half-angle of 45 deg was tested in a hypersonic wind tunnel at a freestream Mach number of 1.16, a Reynolds number of 1,500,000, and angles of attack of 0, 5, and 10 deg. The tests revealed a pronounced pressure drop in an area about the symmetry axis somewhat below the apex of the wing. V.P.

A72-31026 # **Pressure measurement on a vibrating aileron in transonic flow (Izmerenie davleniia na kolebliushchemsia elerone v okolozvukovom potoke).** V. V. Nazarenko and T. P. Nevezhina. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Mar.-Apr. 1972, p. 179-185. 11 refs. In Russian.

Aileron buzz in plane-parallel transonic flow ($M = 0.974$) is studied with the aid of pressure sensors placed inside the aileron models mounted on a symmetric wing profile. The damping characteristics of the aileron are evaluated with allowance for nonlinear effects associated with the motion of the shock during the vibration process. A possible mechanism of control-surface buzz under conditions of mixed flow is proposed. V.P.

A72-31050 **TriStar hydraulics designed for maintainability.** A. A. Nemecek (Lockheed-California Co., Burbank, Calif.). *Hydraulics and Pneumatics*, vol. 25, May 1972, p. 109-111.

Description of the special cartridge valves and manifolds, reservoirs, and hydraulic service center developed to speed L-1011 maintenance and servicing. Directional control valves and shut-off valves used in flight are generally solenoid controlled. Dual solenoids are installed for reliability, and single solenoids are designed for fail-safe operation. Electrical servovalves are used for all primary flight control actuation. All-engine-out power is provided by a simple ram-air turbine drive. F.R.L.

A72-31075 # **Hydrogenated pyrolytic oil as a component of jet fuels (Gidrirovannoe piroliznoe maslo kak komponent reaktivnykh topliv).** M. Popl, M. Kuras, and I. Mostecky (Khimiko-Tekhnologicheskii Institut, Prague, Czechoslovakia). *Khimii i Tekhnologii Topliva i Masel*, vol. 17, no. 3, 1972, p. 48-50. 11 refs. In Russian.

The properties of the hydrogenated aromatic fraction (200 to 330 C) from pyrolytic oil are investigated. It is shown that this product is well suited for use in jet fuels. V.P.

A72-31141 **Advanced air traffic control systems.** J.-A. Dinkespiler (ESRO, Neuilly-sur-Seine, Hauts-de-Seine, France). In: International cooperation in space operations and exploration; Proceedings of the Ninth Goddard Memorial Symposium, Washington, D.C., March 10, 11, 1971. Tarzana, Calif., Univelt, Inc.; American Astronautical Society, 1971, p. 77-82.

A review is presented of the major considerations that are likely to influence the definition of an aeronautical program which will be worldwide in character. Since the aircraft of major airlines fly to all parts of the globe, their equipment, their avionics, their antennas must be used everywhere. The requirements for an operational system are considered together with mission objectives. There are two main categories of missions. The first category is concerned with communications, voice and data transmission between the aircraft and earth stations. The second mission category is surveillance. G.R.

A72-31151 What moves, the airplane or the world. S. L. Johnson and S. N. Roscoe (Illinois, University, Urbana, Ill.). *Human Factors*, vol. 14, Apr. 1972, p. 107-129. 45 refs. Contract No. N00014-6F-A-0305-0014.

The literature pertaining to motion-relationship variables in the display of airplane flight attitude and steering commands and their effects upon pilot performance is reviewed. Factors considered include: (1) figure and ground relationships, (2) control-display relationships, (3) whether the airplane or the horizon is the moving element of the display, and (4) whether the presentation of steering commands results in pursuit or compensatory tracking. The frequency-separation principle is an unexplored approach to the solution of display motion relationship problems. A concluding set of requirements for future research is based on problems encountered in previous investigations of display motion relationships.

(Author)

calculation of profile drag and prediction of boundary layer behavior for airfoils in supersonic flow. It is applied to the biconvex airfoils as an example. Author

STAR ENTRIES

N72-21992 National Aeronautical Establishment, Ottawa (Ontario).

DYNAMIC INTERFERENCE EFFECT ON DYNAMIC STABILITY OF DELTA-WING SHUTTLE IN ABORT SEPARATION AT MACH 2.0

K. J. Orlik-Rueckmann and J. G. LaBerge Nov. 1971 57 p refs

(LTR-UA-18) Avail: Issuing Activity

Damping-in-pitch was measured at Mach 2 on a delta-wing orbiter in close proximity of a synchronously oscillating canard booster. For the single position of the two vehicles that was investigated, it was found that the associated dynamic interference may result in values of the orbiter damping that are between +13 and -8 times the interference-free value, depending on the phase-angle between the two motions. This is in contrast to the static interference caused by a non-oscillating booster, that has previously been shown to have only a minor effect on orbiter damping. It has been found also that the dynamic interference may reduce the frequency of orbiter oscillation, increasing the probability that it may become synchronous with that of the booster. More work is needed to increase our understanding of the effect of dynamic interference so that the design and operation requirements for a safe abort separation can be properly formulated. Author

N72-21994* General Electric Co., Evendale, Ohio. Aircraft Engine Group.

ACOUSTIC TESTING OF A 1.5 PRESSURE RATIO, LOW TIP SPEED FAN (QEP FAN B SCALE MODEL)

S. B. Kazin, W. R. Minzner, and J. E. Peas [1972] 111 p (Contract NAS3-12430)

(NASA-CR-120789) Avail: NTIS CSCL 01A

A scale model (0.484 scale factor) of a single stage fan designed for a 1.5 pressure ratio and 1160 ft/sec tip speed was tested to determine its noise characteristics. The fan had 26 blades and 60 outlet guide vanes, with vanes spaced two rotor blade aerodynamic chords from the blades. The effects of speed, exhaust nozzle area and fan frame acoustic treatment on the scale model's noise characteristics were investigated. Author

N72-21995 National Aerospace Lab., Tokyo (Japan).

A CALCULATION OF THE PROFILE DRAG OF AIRFOILS IN COMPRESSIBLE FLOW

Yoji Ishida Nov. 1971 18 p refs In JAPANESE; ENGLISH summary

(NAL-TR-253) Avail: NTIS

A method is presented for predicting the profile drag of airfoils at subcritical and supersonic Mach numbers. The method consists of four steps of calculations: (1) calculation of the laminar boundary layer by using the Stewartson-illingworth transformation and Thwaites method; (2) calculation of the transition point; (3) calculation of the turbulent boundary layer by Green's method; and (4) calculation of the wake. The calculated or experimental velocity distributions on airfoils must be given in advance, and the transition point must also be given as a parameter. Profile drag was calculated for several types of airfoils at subcritical Mach numbers. A comparison was made with experimental data. This method is also applicable to

N72-21996 Aeronautical Research Labs., Melbourne (Australia). **AN INTRODUCTION TO DYNAMIC DERIVATIVES. THE CONCEPT OF DERIVATIVES**

G. F. Forsyth Jul. 1971 37 p refs

(ARL/A-Note-330; ISBN-642-97701-1) Avail: NTIS

The meaning and importance of various unsteady aerodynamic quantities are discussed. Mathematical analyses of small displacements from the stable condition are presented. The principle variables contributing to aircraft instability are described. Subjects of discussion include: (1) the variable set, (2) similarity invariants, (3) dynamic invariants, and (4) stiffness and damping. Author

N72-21997* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPLORATORY INVESTIGATION OF LIFT INDUCED ON A SWEEP WING BY A TWO-DIMENSIONAL PARTIAL-SPAN DEFLECTED JET AT MACH NUMBERS FROM 0.20 TO 1.30

Francis J. Capone Washington Apr. 1972 80 p refs

(NASA-TM-X-2529; L-8177) Avail: NTIS CSCL 01B

An exploratory investigation was conducted in the Langley 16-foot transonic tunnel at Mach numbers from 0.20 to 1.30 to determine the induced lift characteristics of a body and swept-wing configuration having a partial-span two-dimensional propulsive nozzle with exhaust exit in the notch of the swept-wing trailing edge. The Reynolds number per meter varied from 4,900,000 to 14,030,000. The effects on wing-body characteristics of deflecting the propulsive jet in the flap mode at nominal exhaust-nozzle deflection angles of 0 deg and 30 deg were studied for two nozzle designs with different geometry and wing spans. Author

N72-21998* Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

NUMERICAL SOLUTION OF FLOWFIELDS BEHIND RECTANGULAR WINGS Final Report

Dale Anderson and Jerald Vogel Jul. 1971 79 p refs

(Grant NGR-16-002-029; Proj. 859-S)

(NASA-CR-126214; ISU-ERI-AMES-71015) Avail: NTIS CSCL 01A

The numerical solution of flow fields behind rectangular wings is described. Subjects discussed are: (1) evaluation of various differencing methods applied to the hyperbolic partial differential equations encountered in gas dynamics, (2) application of the numerical differencing techniques to the wedge flow, two dimensional shock reflection for the three dimensional finite thickness wing at zero degrees angle of attack, and (3) calculation of preliminary results for wedge flows using optimum differencing methods. Author

N72-22001 Advisory Group for Aerospace Research and Development, Paris (France).

SOME RECENT DEVELOPMENTS IN PLANAR INVISCID TRANSONIC AIRFOIL THEORY

H. Yoshihara (Gen. Dyn./Convair, San Diego, Calif.) Feb. 1972 38 p refs

(AGARD-AG-156; AGARD; graph-156) Avail: NTIS

Some recent efforts to calculate planar inviscid supercritical flow over airfoils are reviewed giving typical results achieved. The hodograph procedures of Nieuwland and Boerstol, and Garabedian and Korn are first reviewed which yield shockless profiles. The unsteady finite difference procedure of Mannus and Yoshihara is then described and its use then illustrated by

several lifting examples with shocks. This is then followed by a description of two steady procedures. The first is that of Murman and Cole, who used a line relaxation procedure to solve a boundary value problem composed of the transonic perturbation equations with planar boundary conditions. The second is the procedure of Steger and Lomax who used the exact equations, and quasi-planar boundary conditions, and the finite difference relaxation procedure of Murman and Cole. The review is concluded by making a brief assessment of the various methods.

Author

N72-22002# Aeronautical Research Council (Gt. Brit.). Aerodynamics Dept.

THE LINEARIZED SUBSONIC FLOW OVER THE CENTRE-SECTION OF A LIFTING SWEEP WING

Patricia J. Rossiter 1970 33 p refs Supersedes RAE-TR-69072

(ARC-R/M-3630; BR-19914; RAE-TR-69072) Avail: NTIS; HMSO 90p; PHI \$3.65

The linearized equation for the velocity potential of subsonic flow past a semi-infinite plane sector has eigensolutions. These determine the singular behaviour of the loading, according to the linearized theory of subsonic flow, at the leading and trailing edges of the center section of a swept wing. The eigensolutions are proportional to a positive power of the distance from the apex of the sector. Values of the exponents of this factor for the first two eigensolutions are calculated as functions of the apex angle, using a finite difference approximation to the partial differential equation. The first of these corresponds to the strength of the singularity in the loading at the apex of a swept wing and the second, which is compatible with the Kutta-Joukowski condition, describes the rate at which the loading tends to zero as the trailing edge root is approached.

Author

N72-22003*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SOME EFFECTS OF EXTERNAL STORES ON THE STATIC STABILITY OF FIGHTER AIRPLANES

M. Leroy Spearman Washington Apr. 1972 36 p refs Presented at the Aircraft/Stores Compatibility Symp., Dayton, Ohio, 7-9 Dec. 1971

(NASA-TN-D-6775; L-7906) Avail: NTIS CSCL 01B

Fighter airplanes may have a seemingly limitless number of external store arrangements. Some practical considerations and some aerodynamic considerations must be taken into account in the arrangements of the external stores. The nature of the problems concerning the type of store arrangement involved and the type of airplane on which the stores are installed are reported.

Author

N72-22005*# Avco Corp., Wilmington, Mass.

A METHOD FOR ANALYZING DYNAMIC STALL OF HELICOPTER ROTOR BLADES

Peter Crimi and Barry L. Reeves Washington NASA May 1972 110 p refs

(Contract NAS1-10213)

(NASA-CR-2009) Avail: NTIS CSCL 01B

A model for each of the basic flow elements involved in the unsteady stall of a two-dimensional airfoil in incompressible flow is presented. The interaction of these elements is analyzed using a digital computer. Computations of the loading during transient and sinusoidal pitching motions are in good qualitative agreement with measured loads. The method was used to confirm that large torsional response of helicopter blades detected in flight tests can be attributed to dynamic stall.

Author

N72-22007*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LIFTING-SURFACE THEORY FOR CALCULATING THE LOADING INDUCED ON A WING BY A FLAP

Wayne A. Johnson Washington May 1972 20 p refs Prepared Jointly with Army Air Mobility Research and Development Lab., Moffett Field, Calif.

(NASA-TN-D-6798; A-4084) Avail: NTIS CSCL 01A

A method is described for using lifting-surface theory to obtain the pressure distribution on a wing with a trailing-edge flap or control surface. The loading has a logarithmic singularity at the flap edges, which may be determined directly by the method of matched asymptotic expansions. Expressions are given for the singular flap loading for various flap hinge line and side edge geometries, both for steady and unsteady flap deflection. The regular part of the flap loading must be obtained by inverting the lifting-surface-theory integral equation relating the pressure and the downwash on the wing; procedures are described to accomplish this for a general wing and flap geometry. The method is applied to several example wings, and the results are compared with experimental data. Theory and test correlate well.

Author

N72-22010# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

CONTROL AND DISTURBANCE TRANSFER FUNCTION OF LONGITUDINAL AIRCRAFT MOTION WITHOUT AUTOMATIC CONTROL

G. Schaefer 1971 24 p refs In GERMAN; ENGLISH summary Prepared jointly with Bodenseewerk Geraetetechnik (DLR-Mitt-71-11) Avail: NTIS; DFVLR, Porz: 9 DM

Tables are presented of the coefficients of the control and perturbation transfer functions for longitudinal motion of an uncontrolled aircraft in turbulent air conditions. The coefficients are derived from the linear equations of motion. The coefficients of each transfer function are set out in the tables in implicit form as function of the stability derivatives in such a way that the change of sign of the coefficients, leading to instability and non-minimum phase effects, become visible. The stability derivations, causing instability and non-minimum phase effects, are specially indicated.

ESRO

N72-22011# Boeing Co., Philadelphia, Pa. Vertol Div. DESIGN STUDIES AND MODEL TESTS OF THE STOWED TILT ROTOR CONCEPT. VOLUME 8: SUMMARY OF STRUCTURAL DESIGN CRITERIA AND AERODYNAMIC PREDICTION TECHNIQUES Final Report, Dec. 1970 - Jul. 1971

Robin W. Sandford, Francis J. McHugh, Leon N. Delarm, Edward B. Schagrin, and John P. Magee Oct. 1971 280 p refs

(Contract F33615-69-C-1577)

(AD-736021; D213-1000-8-Vol-8; AFFDL-TR-71-62-Vol-8) Avail: NTIS CSCL 01/3

The report presents a summary of the technical data from four wind tunnel tests on tilt and stowed rotor performance and fully dynamic models. Blade loads, dynamic stability, performance, rotor/wing interactions, and stability and control data are presented. The impact of the tests on stowed rotor aircraft design are discussed and recommendations for further technical and design work are provided.

Author (GRA)

N72-22012# Ballistic Research Labs., Aberdeen Proving Ground, Md.

WIND TUNNEL MAGNUS TESTING OF A CANTED FIN OR SELF-ROTATING CONFIGURATION Memorandum Report

A. S. Platou Dec. 1971 19 p ref

(DA Proj. 170-61102-A-33D)

(AD-736369; BRL-MR-2143) Avail: NTIS CSCL 20/4

A source of error in the wind tunnel measurement of Magnus forces and moments on a self-rotating configuration has been detected, and means of overcoming the error are presented. The error is due to a normal force interaction brought about by the roll of the angle of attack plane which in turn is due to a small yaw angle of the model at zero angle of attack. The error is not a balance interaction error. The error can completely mask the true Magnus characteristics and can lead the experimenter to wrong conclusions. Although a computed correction may be made to existing data, the best method of eliminating the error is to obtain balance readings with and without spin at each angle of attack of interest. Author (GRA)

N72-22013*+ Boeing Co., Renton, Wash. Commercial Airplane Div.

SIMULATOR MODEL SPECIFICATION FOR THE AUGMENTOR WING JET STOL RESEARCH AIRCRAFT

P. C. Rumsey and R. E. Spitzer Dec. 1971 105 p ref (Contract NAS2-6025)

(NASA-CR-114434; D6-26065TN) Avail: NTIS CSCL 01B

The configuration and simulation studies of a C-8A (De Havilland Buffalo) aircraft are described. The modifications to STOL configuration consisted of augmentor-wing jet flaps, blown and drooped ailerons, and leading edge slats. The total simulator model includes a number of component parts for producing realistic visual, aural, tactile, vestibular, and kinesthetic cues for the pilot to assess the predicted behavior of the real airplane.

Author

N72-22014*+ Boeing Co., Renton, Wash. Commercial Airplane Div.

A DESIGN SUPPORT SIMULATION OF THE AUGMENTOR WING JET STOL RESEARCH AIRCRAFT

P. C. Rumsey, R. E. Spitzer, and W. L. B. Glende Jan. 1972 160 p ref

(Contract NAS2-6025)

(NASA-CR-114435; D6-24806-1) Avail: NTIS CSCL 01B

The modification of a C-8A (De Havilland Buffalo) aircraft to a STOL configuration is discussed. The modification consisted of the installation of an augmentor-wing jet flap system. System design requirements were investigated for the lateral and directional flight control systems, the lateral and directional axes stability augmentation systems, the engine and Pegasus nozzle control systems, and the hydraulic systems. Operational techniques for STOL landings, control of engine failures, and pilot techniques for improving engine-out go-around performance were examined. Design changes have been identified to correct deficiencies in areas of the airplane control systems and to improve the airplane flying qualities.

Author

N72-22015*# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.

SUMMARY AND RECOMMENDATIONS FOR THE NASA/MIT WORKSHOP ON SHORT HAUL AIR TRANSPORT

Robert W. Simpson Oct. 1971 122 p

(Contract NSR-22-009-631)

(NASA-CR-126135; FTL-R-71-4) Avail: NTIS CSCL 15E

The material is summarized that was covered by the MIT/NASA Waterville Valley workshop which dealt with the institutional, socio-economic, operational and technological problems associated with introducing new forms of short haul domestic air transportation. It was found that future air systems hold great potential in satisfying society's needs for a low noise, low landscape, high access, high speed, large network system for public travel over distances between 5 and 500 miles. It is concluded that quiet air systems are necessary for obtaining community approval, and is recommended that extremely high priority be assigned to the development of quiet aircraft for future short haul air systems.

F.O.S.

N72-22016# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: CONTINENTAL AIR LINES, INCORPORATED, BOEING 707-320C, N47330 AND FLOYD FLYING SERVICE, CESSNA 150J, N61011, COMPTON, CALIFORNIA, AUGUST 4, 1971

29 Dec. 1971 14 p

(NTSB-AAR-72-5) Avail: NTIS

An aircraft accident report of a midair collision between a Boeing 707 airliner and a Cessna 150 aircraft is presented. The incident occurred over Compton, California on August 4, 1971. Both aircraft landed safely and injuries occurred only to the two persons in the Cessna aircraft. Cause of the accident was due to atmospheric lighting conditions which reduced the visibility range and blanking of the Cessna pilot's vision by the wing of the smaller aircraft.

Author

N72-22017# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: TRANS WORLD AIRLINES, INCORPORATED, BOEING 707, N6729TW AND AMERICAN AIRLINES, INCORPORATED, BOEING 707, N8432, NEAR PHILIPSBURG, PENNSYLVANIA, 11 JUNE 1971

29 Dec. 1971 16 p

(NTSB-AAR-72-7) Avail: NTIS

A Trans World Airlines (TWA) Boeing 707, N6729TW, and an American Airlines Boeing 707, N84432, narrowly avoided a midair collision at approximately 35,000 feet near Philipsburg, Pennsylvania, on June 11, 1971, while operating within positive control airspace under the control jurisdiction of the New York Air Route Traffic Control Center. As a result of the violent evasive maneuver executed by the captain of the TWA B-707, three passengers and the flight engineer incurred minor injuries, but did not require immediate medical attention. None of the occupants of the other aircraft, whose crew was unaware of the occurrence until some time later, was injured. There was no damage to either aircraft, both of which proceeded routinely to their respective destinations. The National Transportation Safety Board determines that the probable cause of this incident was the controller's misidentification of the radar target of TW flight 31, N6729TW, due to a transitory diversion of attention to another portion of the radar display. This resulted in inappropriate traffic control actions with respect to the American Airlines aircraft and placed the two flights on a collision course at the same altitude.

Author

N72-22018# Cranfield Inst. of Technology (England). Dept. of Aerodynamics.

THE EFFECT OF LIFT-SYSTEM AIRFLOW ON THE HULL AERODYNAMICS OF HOVERCRAFT

E. J. Andrews Aug. 1971 58 p refs

(Cranfield-Aero-7) Avail: NTIS

An attempt was made to provide a better understanding of the influence of aerodynamic characteristics on the handling qualities of amphibious hovercraft. The following were explored: (1) aerodynamic characteristics of related hovercraft shapes; (2) the effect of cushion efflux on external aerodynamic characteristics; (3) the effects of lift-system airflow and the location of induction ports on the aerodynamic characteristics of hovercraft hulls. It was established that no major effects of consequence exist, yet, certain measures can be taken during the design stages of hulls, skirts and induction ports that will minimize inherent adverse characteristics.

Author

N72-22019*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

OPTIMUM PERFORMANCE OF HOVERING ROTORS

J. C. Wu (Georgia Inst. of Tech., Atlanta) and P. M. Goorjian Mar. 1972 54 p

(NASA-TM-X-62138) Avail: NTIS CSCL 01B

A theory for the optimum performance of a rotor hovering out of ground effect is developed. The performance problem is formulated using general momentum theory for an infinitely bladed rotor, and the effect of a finite number of blades is estimated. The analysis takes advantage of the fact that a simple relation exists between the radial distributions of static pressure and angular velocity in the ultimate wake, far downstream of the rotor, since the radial velocity vanishes there. This relation permits the establishment of an optimum performance criterion in terms of the ultimate wake velocities by introducing a small local perturbation of the rotational velocity and requiring the resulting ratio of thrust and power changes to be independent of the radial location of the perturbation. This analysis fully accounts for the changes in static pressure distribution and axial velocity distribution throughout the wake as the result of the local perturbation of the rotational velocity component. Author

N72-22020# National Transportation Safety Board, Washington, D.C.

STUDY OF LESSONS TO BE LEARNED FROM ACCIDENTS ATTRIBUTED TO TURBULENCE

15 Dec. 1971 /2 p

(NTSB-AAS-71-1) Avail: NTIS

Turbulence-involved U. S. air carrier accidents occurring from 1964-1969 are presented. Based on the detailed investigation of those accidents, lessons to be learned primarily from the point of view of the meteorologist, the air carrier and the pilot are discussed. Observations are made and conclusions drawn in regard to such factors as the adequacy of CAT (clear air turbulence) versus thunderstorm-associated turbulence forecasts, the use of airborne weather radar as a thunderstorm avoidance tool, airborne weather radar maintenance problems, the requirement for real-time data in the cockpit, CAT detectors, turbulence associated losses, the nuisance problem and information derived from cockpit voice recorders and flight data recorders. Author

N72-22021# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT PRELIMINARY REPORT: MOHAWK AIRLINES, INC., FAIRCHILD HILLER, FH-227B, N7818M, ALBANY, NEW YORK, 3 MARCH 1972

14 Apr. 1972 10 p

(SB-72-23) Avail: NTIS

The aircraft accident involving a Fairchild-Hiller 227B transport with 45 passengers and a crew of 3 which crashed south of the Albany County Airport, New York, on March 3, 1972 is reported. The aircraft was conducting a backcourse instrument landing system approach when the crew reported a problem with the left engine. About 32 seconds later, the crew reported that they were in trouble and would be landing short. The aircraft struck a house near the airport. Author

N72-22022*# Barry Wright Corp., Watertown, Mass.
DESIGN, FABRICATION AND TESTING OF TWO ELECTROHYDRAULIC VIBRATION ISOLATION SYSTEMS FOR HELICOPTER ENVIRONMENTS

Rush E. Allen and Peter C. Calcaterra [1972] 60 p refs
(Contract NAS1-10103)

(NASA-CR-112052) Avail: NTIS CSCL 01B

Two electrohydraulic vibration isolation systems were designed and fabricated to reduce the vertical vibrations transmitted to the XH-51N research helicopter cabin at the blade passage frequency (18 Hz) and its first harmonic (36 Hz). Hydraulic power and electrical control are provided to two separate servoactuators from a common power supply and control electronics package located behind the pilot's seat. One servoactuator is installed between the cabin and fuselage and

replaces an existing passive spring. A second servoactuator is mounted between the existing seat and cabin floor. Both servoactuators incorporate a mechanical failsafe design. The control electronics circuitry provides automatic tracking of the blade passage frequency. Results of laboratory, environmental and ground vibration tests employing an XH-51A stripped down helicopter fuselage show that the active cabin isolator reduces the vertical vibrations transmitted from the fuselage attachment point to the cabin attachment point at 18 and 36 Hz (or as an alternative, 6 Hz) by better than 90 percent. Author

N72-22023*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

THREE-TRACK RUNWAY AND TAXIWAY PROFILES MEASURED AT INTERNATIONAL AIRPORTS G AND H

Albert W. Hall Washington Apr. 1972 105 p refs

(NASA-TN-D-6680; L-8189) Avail: NTIS CSCL 01B

Three-track runway and taxiway profiles are presented for use in studies of airplane response to ground roughness. This report presents the tabulated and plotted data for two international airports (designated airports G and H). Author

N72-22024*# Bell Aerospace Co., Buffalo, N.Y.

EVALUATION OF ACTIVE COOLING SYSTEMS FOR A MACH 6 HYPERSONIC TRANSPORT AIRFRAME, PART 2 Final Report

R. G. Helenbrook, W. A. McConarty, and F. M. Anthony Washington NASA Dec. 1971 194 p refs

(Contract NAS1-7468)

(NASA-CR-1917; Rept-7305-902001-Pt-2) Avail: NTIS CSCL 01B

Transpiration and convective cooling concepts are examined for the fuselage and tail surface of a Mach 6 hypersonic transport aircraft. Hydrogen, helium, and water are considered as coolants. Heat shields and radiation barriers are examined to reduce heat flow to the cooled structures. The weight and insulation requirements for the cryogenic fuel tanks are examined so that realistic totals can be estimated for the complete fuselage and tail. Structural temperatures are varied to allow comparison of aluminum alloy, titanium alloy, and superalloy construction materials. The results of the study are combined with results obtained on the wing structure, obtained in a previous study, to estimate weights for the complete airframe. The concepts are compared among themselves, and with the uncooled concept on the basis of structural weight, cooling system weight, and coolant weight. Author

N72-22025# Rowland and Co., Haddonfield, N.J.

AIRCRAFT EXTERIOR LIGHTING AND MARKING Final Report, Jan. 1971 - Jan. 1972

George E. Rowland and Carl A. Silver May 1972 110 p refs
(Contract DOT-FA69NA-357)

(FAA-NA-72-29; Rept-72-24) Avail: NTIS

The contemporary state of human factors knowledge concerning aircraft exterior lighting and marking is investigated. Efforts to increase conspicuity in the absence of an unforeseen technological breakthrough, will probably continue to be essentially useless. A simple white-on-top, black-on-bottom paint scheme, which leaves about one-fourth of a metal aircraft bright aluminum to cause specular reflection of sunshine, is recommended as the most likely overall compromise paint design. Author

N72-22026*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

IN-FLIGHT PILOT EVALUATIONS OF THE FLYING QUALITIES OF A FOUR-ENGINE JET TRANSPORT

Euclid C. Holleman and Glenn B. Gilyard Washington May 1972 54 p refs
(NASA-TN-D-6811; H-680) Avail: NTIS CSCL 01B

The flying qualities of the CV-990 jet transport were evaluated over the normal operating flight envelope and in smooth air to provide baseline data for transport airplanes. Pilot ratings of airplane handling characteristics for specific test conditions and configurations from approach to normal cruise were compared with various flying qualities criteria. In general, the CV-990 flying qualities were evaluated as satisfactory, and the evaluations supported transport flying qualities criteria. The Dutch roll damping was rated more satisfactory than was predicted by the flying qualities criteria. The pilots found rudder coordination for the yaw generated during high roll rates very difficult. They preferred to control with roll and pitch controls and to use the yaw damper to provide the required rudder coordination. Author

N72-22027* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC DAMPING AND OSCILLATORY STABILITY IN PITCH AND YAW FROM A MODEL OF A VARIABLE-SWEEP FIGHTER AIRPLANE WITH TWIN VERTICAL TAILS

Robert A. Kilgore and Jerry B. Adcock Washington May 1972 41 p refs
(NASA-TM-X-2555; L-8025) Avail: NTIS CSCL 01B

Wind-tunnel measurements of the aerodynamic damping and oscillatory in pitch and yaw for a 1/22-scale model of a proposed carrier-based variable-sweep fighter airplane have been made by using a small-amplitude forced-oscillation technique. Tests were made with a wing leading-edge sweep angle of 68 deg at angles of attack from about -1.5 deg to 15.6 deg at a Mach number of 1.60 and at angles of attack from about -3 deg to 21 deg at Mach numbers of 2.02 and 2.36. The results of the investigation indicate that the basic configuration has positive damping and positive oscillatory stability in pitch for all test conditions. In yaw, the damping is generally positive except near an angle of attack of 0 deg at a Mach number of 1.60. The oscillatory stability in yaw is positive except at angles of attack above 16 deg at Mach numbers of 2.02 and 2.36. The addition of external stores generally causes increases in both pitch and yaw damping. The oscillatory stability in pitch is reduced throughout the angle-of-attack range by the addition of the external stores. The effect of adding stores on the oscillatory stability in yaw is a function of angle of attack and Mach number. The effect of changing horizontal-tail incidence on the pitch parameters is also very dependent on angle of attack and Mach number. Author

N72-22028* National Transportation Safety Board, Washington, D.C.

SPECIAL STUDY: CARBURETOR ICE IN GENERAL AVIATION

19 Jan. 1972 13 p
(NTSB-AAS-72-1) Avail: NTIS

The carburetor ice to which reciprocating engine installations are susceptible was a probable cause or factor in 360 general aviation accidents over a recent 5-year period. In these accidents there were 40 fatalities and 160 people injured out of a total of 636 persons aboard. Such losses as these can be reduced through the exercise of greater pilot awareness and vigilance. Included in this report are descriptions of conditions conducive to carburetor icing, modes of carburetor icing, and procedures for circumventing power loss due to carburetor ice. It is believed that reduction of carburetor icing accidents is attainable through further pilot education, and that the most effective means of accomplishing this would be for the Federal Aviation Administration to send a carburetor ice advisory to each of its registered pilots. Author

N72-22029* Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

OUTSTANDING PROBLEMS OF AIRCRAFT AERODYNAMICS [OFFENE PROBLEME DER FLUGZEUG-AERODYNAMIK]

J. Barche 1971 34 p refs In GERMAN Presented at the 4th DGLR Annual Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971

Avail: NTIS

Some of the problems which have been met in the development of aircraft projects are analyzed. The problem is limited to subsonic and transonic transport and military aircraft.

ESRO

N72-22030* United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

INVESTIGATION OF THE STABILATOR ON THE S-67 AIRCRAFT Final Report

Thaddeus T. Kaplita Oct. 1971 110 p refs
(Contract DAAJ02-71-C-0010; DA Proj. 1F1-63204-D-157)
(AD-735766; SER-67006; USAAMRDL-TR-71-55) Avail: NTIS CSCL 01/3

A flight test and simulation investigation of the S-67 stabilator was conducted. The S-67 stabilator, an all-movable, in-flight-trimmable horizontal stabilizer, is coupled to the longitudinal cyclic control in forward flight and may be uncoupled to free-float in hover. The flight tests included hover, transitions, low- and high-speed flight, autorotation, and stabilator bias actuator hardovers. In the simulation study, stabilator design was varied to establish trends due to design changes. The existing stabilator design will provide the aircraft with acceptable trim and static stability for the full G. W. and C. G. envelope. In-flight trimmability provides control of fuselage attitude independent of the rotor. Author (GRA)

N72-22032* Naval Air Development Center, Johnsville, Pa. Aero Mechanics Dept.

AIR SKIMMER PROGRAM (X-28A) Final Report

Nicholas E. Dapuzzo 30 Dec. 1971 19 p refs
(AD-736187; NADC-AM-7140) Avail: NTIS CSCL 01/3

The objective of the task was to explore the potential usefulness of a small, single-seat seaplane for civil police patrol duties in Southeast Asia. Investigation of existing private and sport aircraft and subsequent flight evaluation testing of one such vehicle indicate that the Osprey 1, Navy designation X-28A, may afford a good baseline configuration which with certain refinements could provide a vehicle suitable for operational use.

GRA

N72-22033* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REDUCTION IN FLUTTER INSTABILITY OF AN ELASTIC BEAM WITH THE RIGID EMPENNAGE IN SUPERSONIC FLOW

I. T. Selezov and G. T. Kovbasa 18 Nov. 1971 14 p refs Transl. into ENGLISH from *Gidraeromekhan. i Teoriya Uprugosti* (USSR), no. 9, 1970 p 29-34

(AD-736487; FTD-MT-24-97-71) Avail: NTIS CSCL 01/3

The possibility of the expansion of the region of dynamic elastic stability of a finned beam streamlined by a supersonic gas flow is investigated. In order to do this a system of automatic control, which consists of the object of control, measuring elements and actuators, is used. GRA

N72-22034* RAND Corp., Santa Monica, Calif.

AIRFRAME STRUCTURAL MATERIALS FOR DRONE APPLICATIONS

Donald F. Adams Jul. 1971 49 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189)
(AD-736616; R-581/4-ARPA) Avail: NTIS CSCL 01/3

A comparison was made of performance, weight, and cost characteristics of a wide range of structural materials for aircraft. Materials ranging from polyester-impregnated paper and wood to titanium and the high-performance reinforced composites are compared with conventional aluminum alloys for subsonic vehicles. At high supersonic speeds, aerodynamic heating dictates use of high-temperature materials such as coated columbium, molybdenum, and TD nickel alloys. Fuselage, wing, tail, and engine nacelle components are individually considered for 5 representative subsonic and 3 supersonic configurations; 9 different material combinations are evaluated for the subsonic and 8 for the supersonic vehicles.

Author (GRA)

N72-22035# Boeing Co., Philadelphia, Pa. Vertol Div.
DESIGN STUDIES AND MODEL TESTS OF THE STOWED TILT ROTOR CONCEPT. VOLUME 9: VALUE ENGINEERING REPORT Final Report
Jaan Liiva and H. J. Rose Oct. 1971 66 p
(Contract F33615-69-C-1577)
(AD-736222; D213-10000-9-Vol-9; AFFDL-TR-71-62-Vol-9)
Avail: NTIS CSCL 01/3

The report describes and compares the technical and cost issues of flush and edgewise folding of the rotor blades for a stowed tilt rotor aircraft. Four different folding actuation schemes are presented. A cost saving recommendation is also made for the hub costing.

Author (GRA)

N72-22036# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
GROUND TEST EVALUATION OF THE SIKORSKY ACTIVE TRANSMISSION ISOLATION SYSTEM Final Technical Report, 1 Jul. 1969 - 31 Oct. 1970
Paul W. VonHardenberg and Paul B. Saltanis Sep. 1971 129 p refs
(Contract DAAJ02-69-C-0101; DA Proj. 1F1-62204-A-146)
(AD-736347; SER-50682; USAAMRDL-TR-71-38) Avail: NTIS CSCL 13/9

Active isolation of a full-scale CH-53A helicopter fuselage was successfully demonstrated during hangar shake tests. Overall reductions of approximately 70 percent in fuselage response to main rotor 6p excitations were achieved, while sensitivity to 1p in-plane excitation was increased by only 13 percent. These isolation levels were achieved with a design constrained by the geometry of the CH-53A fuselage. Analytical studies indicate that further reductions in vibratory response could be achieved if fuselage and isolation system design were integrated.

Author (GRA)

N72-22037# Systems Research Labs., Inc., Dayton, Ohio.
DEVELOPMENT OF AN RF-4C REFUELING TRAINING PROGRAM FROM COMPUTER-BASED SYSTEMS DATA Final Report
Horace H. Valverde, Charles F. Hicks, and Ned H. Kearns
Brooks AFB Texas AFHRL Jun. 1971 109 p refs
(AF Proj. 1710)
(AD-736409; AFHRL-TR-71-25) Avail: NTIS CSCL 05/9

The report describes the development of a systems approach to RF-4C air refueling training. The primary objective of the effort was to develop an instructional plan, or blueprint, using a format which facilitates the utilization of existing computer-based task data by training personnel. The training plan was developed for use by Tactical Air Reconnaissance Center instructor personnel in training RF-4C aircrews to effectively perform KC-135 air refueling requirements.

Author (GRA)

N72-22038# Honeywell, Inc., St. Paul, Minn. Systems and Research Center.

DISPLAY AND RELATED SYSTEM REQUIREMENTS FOR IFR STEEP APPROACH Final Report, Nov. 1967 - Aug. 1971

James D. Wolf Jan. 1972 179 p refs
(Contract N00014-68-C-0191; NR Proj. 213-061)
(AD-736247; JANAIR-711106; Rept-12571-FR4) Avail: NTIS CSCL 01/4

The objective was to establish display information and subsystem requirements for manually controlled steep-angle approach and landing under IFR flight conditions with vertical-lift aircraft. Investigations were conducted as a series of iterative analyses and the real-time man-in-the-loop simulations to evaluate selected display formats, themselves, as well as the effects which relevant system and environmental variables have upon piloting task performance. Alternative display formats were initially tested under idealized flight conditions. The testing of selected formats was then continued in a series of simulation studies in which system and environmental characteristics were systematically introduced to determine their individual and interactive effects upon piloting performance.

Author (GRA)

N72-22039# RAND Corp., Santa Monica, Calif.
A STUDY OF IRAN EFFECTIVENESS FOR THE F-106
Theodore S. Donaldson Oct. 1971 34 p refs
(Contract F44620-67-C-0045)

(AD-736410; R-755-PR) Avail: NTIS CSCL 01/3

The report describes an investigation of the effect of IRAN (inspect and repair as necessary) depot maintenance on the F-106 aircraft. This effect is measured in terms of aircraft performance (using ADCM 66-28 data) before and after IRAN, and in terms of interval length between successive IRANs. Results indicate that aircraft are not in a degraded condition prior to IRAN, and are not improved by IRAN. Further, aircraft with long intervals (calendar time or flying hours) between successive IRANs are not in worse condition than those with short intervals.

Author (GRA)

N72-22040# Army Aeromedical Research Lab., Fort Rucker, Ala.
DYNAMIC AND CRASHWORTHY EVALUATION OF THE UH-1B, C, D, H. MEDICAL ATTENDANT'S SEAT
Errol B. Barber, Stanley C. Knapp, G. E. Tornquist, S. P. Desjardins, and Felix T. Aguilar Jan. 1972 97 p
(AD-737197; USAARL-72-07) Avail: NTIS CSCL 01/3

The challenge was to evaluate the crashworthiness of the UH-1 medical attendant's seat and investigate the feasibility of modifications to improve the seat and its restraint system. This report is a record of USAARL'S involvement, from researching the background to achieve a proper direction for study, through accident statistics, stress analysis, dynamic test program, reduction of data, interpretation, conclusion and, finally, feasible recommendations. The seat was found to be completely noncrashworthy and a direct contributor of serious injuries to its occupants, mostly to the upper torso and head because of poor occupant restraint. Its construction and manufacture did not meet all of the design criteria of military seat specifications. The dynamic tests of the seat demonstrated that with the addition of an inertia reel, shoulder harness, and attachment of the lap belt to the floor a seat occupant could be satisfactorily restrained despite serious seat failure during a crash. The proposed modifications in kit form will provide the seats occupant with the greatest increase in safety and retention, should crash occur, for the lowest dollar investment and down time required for its installation.

Author (GRA)

N72-22099*# Systems Technology, Inc., Hawthorne, Calif.
DEVELOPMENT OF A CATEGORY 2 APPROACH SYSTEM MODEL
Walter A. Johnson and Duane T. McRuer Washington NASA May 1972 92 p refs

(Contract NAS2-4892)

(NASA-CR-2022; TR-182-2) Avail: NTIS CSCL 01B

An analytical model is presented which provides, as its primary output, the probability of a successful Category II approach. Typical applications are included using several example systems (manual and automatic) which are subjected to random gusts and deterministic wind shear. The primary purpose of the approach system model is to establish a structure containing the system elements, command inputs, disturbances, and their interactions in an analytical framework so that the relative effects of changes in the various system elements on precision of control and available margins of safety can be estimated. The model is intended to provide insight for the design and integration of suitable autopilot, display, and navigation elements; and to assess the interaction of such elements with the pilot/copilot.

Author

N72-22246* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

VARIABLE GEOMETRY WIND TUNNELS Patent

Harry H. Heyson, inventor (to NASA) Issued 16 Nov. 1971
7 p Filed 20 Oct. 1969

(NASA-Case-XLA-07430; US-Patent-3,620,076;

US-Patent-Appl-SN-867841; US-Patent-Class-73-147) Avail:
US Patent Office CSCL 14B

A variable geometry wind tunnel is described for testing aircraft models in subsonic tests representing the low speed phases of flight. The system provides for variation of the test section of the tunnel during a test and reduces the corrections needed in data obtained in subsonic wind tunnel tests. The system is computerized to attain optimum test conditions.

Official Gazette of the U.S. Patent Office

N72-22248# Federal Aviation Administration, Washington, D.C.
**MEASUREMENT OF RUNWAY FRICTION: AIRPLANE/
DBV/MU-METER CORRELATION TESTS Progress Report**

1 Jan. 1972 21 p refs

(FS-160-65-68-4; Rept-72-00187) Avail: NTIS

The results are summarized from tests of a Boeing 727-100 Aircraft, a diagonally braked vehicle, and a Mu-Meter on six runway surfaces under dry and artificially wet conditions. Author

N72-22327# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

EVALUATION OF DOW CHEMICAL COMPANY EXTRUDED ALUMINUM TWO-PIECE 2 FT BY 12 FT LANDING MAT, MX18-D Final Report

Dewey W. White, Jr. Dec. 1971 61 p refs

(DA Proj. 1G6-64717-DH-01)

(AD-735345; AEWES-MISC-Paper-S-71-2) Avail: NTIS CSCL 01/5

The investigation reported was conducted to evaluate an extruded aluminum alloy landing mat (designated MX18-D) designed and extruded by the Dow Chemical Company, Midland, Michigan. The mat is a 2 by 12-ft, two-piece partially hollow 6061-T6 aluminum alloy panel. (Two 12-in.-wide extrusions are welded together along their longitudinal edges to form a 2-ft-wide wide panel.) The panels are interlocked along the sides by a hinge-type connector, the components of which are an integral part of the basic panel extrusion. Extruded aluminum edge connectors are welded to the basic panel and consist of an overlap and underlap section secured by a locking bar after individual panels have been joined together. This investigation consisted of engineering traffic tests to evaluate the design and performance of the Dow MX18-D mat for compliance with criteria specified in the Department of the Army approved Qualitative Materiel Requirement (QMR) for Prefabricated Airfield Surfacing.

Author (GRA)

N72-22328# ARO, Inc., Arnold Air Force Station, Tenn.**WIND TUNNEL INVESTIGATION OF THE TRANSONIC AERODYNAMIC CHARACTERISTICS OF A FULL-SCALE FLIGHT PATH ACCELEROMETER (FOLLOW-ON TEST) Final Report**

T. O. Shadow AEDC Feb. 1972 41 p refs

(Contract F40600-72-C-0003; AF Proj. 6903; ARO Proj. PC0216)

(AD-736456; AEDC-TR-72-1; ARO-PWT-TR-71-232) Avail: NTIS CSCL 14/2

A wind tunnel investigation was conducted on a full-scale flight path accelerometer (FPA), to eliminate shock interaction effects between the angle-of-attack and sideslip vanes and to determine angle-of-attack and angle-of-sideslip vane position errors. The shock interference effects were controlled by increasing the axial separation distance between the angle-of-attack and sideslip vanes.

Author(GRA)

N72-22333# National Aerospace Lab., Tokyo (Japan).**ON THE THEORY OF FREE STREAMLINES PAST ARBITRARY OBSTACLES**

Hitoshi Takahashi Sep. 1971 15 p refs In JAPANESE;
ENGLISH summary

(NAL-TR-247) Avail: NTIS

Free streamline theory was used for obtaining pressure distribution on an airfoil with flow separation. The theory of a free streamline past a circular cylinder was extended to the case of an arbitrary obstacle by a numerical method. Flow velocity along the free streamline is assumed to be equal to the free stream velocity. The classical method of calculation was used and correction was made to introduce the effects of base pressure. Examples are presented for the computations of circular cylinders and airfoils with several base pressures, and fair agreement was obtained between theory and experiment.

Author

N72-22351# Oklahoma State Univ., Stillwater.**LASER DOPPLER VELOCIMETER MEASUREMENTS IN A TURBULENT JET EXITING INTO A CROSS FLOW Final Report, Jun. 1970 - Jun. 1971**

Dennis K. McLaughlin Arnold AF Station, Tenn. AEDC Jan. 1972 37 p refs

(Contract F40600-70-C-0005)

(AD-736028; AEDC-TR-71-262) Avail: NTIS CSCL 20/4

Measurements were made of horizontal and vertical velocity components along the center line plane of a turbulent jet exiting into a cross flow. The dual scatter laser Doppler velocimeter was used in both the continuous wave mode and the individual realization mode. In the latter case, numerical averaging over many individual measurements was used to compute the average velocity components. Encouraging results were obtained which indicate that the laser Doppler velocimeter will become an important tool in the field of experimental fluid mechanics.

Author (GRA)

N72-22472# Aeronautical Quality Assurance Directorate, Uxbridge (England).

THE USE OF PAPER-BASED EMULSIONS IN INDUSTRIAL RADIOGRAPHY

J. C. Rockley and D. A. Croft Apr. 1971 34 p refs

(AQD/XNDT-001158; BR-24924) Avail: NTIS

The radiographic characteristics of four types of photographic paper are investigated. It is found that a developer-incorporated printing paper, when exposed in conjunction with a fluorescent slit screen, is capable of giving radiographs of surprisingly high quality when produced at radiation energies not exceeding 200 KV. The economic advantages arising from the use of this type of radiograph in suitable applications are discussed.

Author (ESRO)

N72-22495# Aeronautical Research Labs., Melbourne (Australia). **ANALYSIS OF SAFE FATIGUE LIFE AND SAFE INSPECTION INTERVALS BY RELIABILITY AND CONVENTIONAL THEORY**

F. H. Hooke Jul. 1971 15 p refs
(ARL/SM-335; ISBN-642-97706-2) Avail: NTIS

Both the conventional and reliability analyses for determining safe fatigue life are predicated on a population having a specified (usually log-normal) distribution of life-to-collapse under a fatigue test load. Under a random service load spectrum, random occurrences of load larger than the fatigue test load may confront and cause collapse of structures which are weakened, though not yet to the fatigue test load. These collapses are included in reliability but excluded in conventional analysis. The theory of risk determination by each method is given, and several reasonably typical examples were worked out, in which it transpires that if one excludes collapse through exceedance of the uncracked strength, the reliability and conventional analyses gave virtually identical probabilities of failure or survival. Author

N72-22496*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCED AIRBREATHING ENGINE LUBRICANTS STUDY WITH A TETRAESTER FLUID AND A SYNTHETIC PARAFFINIC OIL AT 492 K (425 F)

Erwin V. Zaretsky and Eric N. Bamberger (GE Co., Cincinnati, Ohio) Washington Apr. 1972 23 p refs
(NASA-TN-D-6771; E-6541) Avail: NTIS CSCL 11H

Groups of 120-mm-bore angular-contact ball bearings made from AISI M-50 steel were fatigue tested with a tetraester and a synthetic paraffinic oil at a bearing temperature of 492 K (425 F) in an air environment. Bearing life exceeded AFBMA-predicted (catalog) life by factors in excess of 4 and 10 for the tetraester and synthetic paraffinic fluids, respectively. The final viscosities after 500 hours of operation were 14 and 6 times the initial values, respectively. During the same time period, when the test oil is replaced at a rate approximating the replenishment rate in actual commercial engine usage, no significant increase in lubricant viscosity with time was observed. Author

N72-22511# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

TITANIUM POWER METALLURGY FORGINGS Final Technical Report, 15 Mar. 1968 - 30 Jun. 1971

Roger E. Peebles Wright-Patterson AFB, Ohio AFML Sep. 1971 284 p refs
(Contract F33615-68-C-1356; AF Proj. 183-3)
(AD-736477; Rept-71-AEG295; AFML-TR-71-148) Avail: NTIS CSCL 13/8

The objective of the contract effort was to ascertain the processing sequences and methods needed to produce precision forged structural and jet engine components from metal powder preforms of titanium alloys. This objective was attained in that an economical powder production process (Hydride-Dehydride) was identified. A technique isostatic pressing followed by high temperature vacuum sintering was identified and a procedure established to consolidate the powders into complex forging preforms and configurations at about 85 to 90% theoretical density. The forging sequence to density these preforms to 100% theoretical density was established. Author (GRA)

N72-22524# Technische Univ., Berlin (West Germany). Inst. fuer Flugfuehrung und Luftverkehr.

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF THE USE OF LASERS FOR SOLVING MEASURING AND PRECISION ENGINEERING PROBLEMS CONCERNING INERTIAL GUIDANCE AND NAVIGATION [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN UEBER DEN EINSATZ VON LASERN ZUR LOESUNG VON

MESS- UND FEINWERKTECHNISCHEN PROBLEMEN DER INERTIALEN LENK- UND NAVIGATIONSTECHNIK]

W. Holzapfel 1971 202 p refs In GERMAN
(Rept-59) Avail: NTIS

The application of lasers to rotary gyroscope vibration analysis, gyroscope balancing, and gravimetric accelerometers is investigated. A laser interferometric method is described for the precise determination of the amplitude and phase of flywheel vibrations. In addition, the rotary and translatory vibration of the gyroscope due to dynamic or static unbalance is identified. Methods for the balancing of gyroscopes during rotation using material eroding pulsed laser radiation are discussed. The concept and properties of a sensitive acceleration measuring instrument, based on gravimetric principles and using laser techniques, are discussed. ESRO

N72-22598# Bureau of Meteorology, Melbourne (Australia). **REGIONAL INCIDENCE OF CAT AND THE METEOROLOGICAL INTERPRETATION OF ROUTINE FLIGHT LOAD RECORDS**

K. T. Spillane Nov. 1971 58 p refs
(Meteorol-Study-21) Avail: NTIS

Seasonal flight loads recorded on routine operations by an F.27 aircraft in Western Australia are examined at two g levels, each of which is contributed by turbulence of significantly different intensity, if all aeronautical turbulence contributing c.g. loads observe similarity in spectra. Examination of the seasonal and diurnal variation of severe convection (thunderstorms) points to the occurrence of seasonal anomalies in loads that are consistent with short length scale CAT mechanisms and are correlated with the seasonal behaviour of the subtropical jet over Western Australia. The power-spectra model of atmospheric turbulence proposed by the Federal Aviation Agency of America is shown to be seasonally nonstationary. Author

N72-22599# Bureau of Meteorology, Melbourne (Australia). **A SINGLE-STATION ANALYSIS OF CLEAR AIR TURBULENCE AND RELATED ATMOSPHERIC STRUCTURE**

K. T. Spillane and U. Radok (Melbourne Univ.) Nov. 1971 47 p refs
(Meteorol-Study-20) Avail: NTIS

Pilotless aircraft operating close to Woomera aerological station provided semi-quantitative data on clear air turbulence (CAT) intensity and incidence up to 65,000 ft. An analysis of upper wind and temperature soundings in terms of the main parameters for which association with CAT is claimed shows the Colson-Panofsky index to be most consistently related to the occurrence and intensity of turbulence. For this it is necessary to define an effective critical Richardson number from the condition of energy balance in a layer 14,000 ft deep and centered on the level of turbulence. The modified index so obtained defines the Jindivik index (J.I.). The average profile of J.I. shows a sharp drop from positive to negative values just above the turbulence level. In conjunction with the mean profiles of wind shear and static stability this suggests that CAT of aeronautical significance represents a vertical convergence of impulses spreading and decaying to smaller scales in a region of reduced static stability. Author

N72-22603# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.

POTENTIAL ECONOMIC BENEFITS OF FOG DISPERSAL IN THE TERMINAL AREA. PART 2: FINDINGS Final Report

Nov. 1971 360 p refs
(FAA Proj. RD-260-001-01R)
(AD-735214; FAA-RD-71-44-2-Pt-2) Avail: NTIS HC\$6.00/MF \$0.95 CSCL 04/2

The study was designed to provide estimates of the costs of disruptions (delays, diversions, and cancellations) of aircraft arrivals (landings) associated with a number of Category II and

III weather situations, with the emphasis on fog situations, at some of the major air carrier airports in the United States. As such they would be measures of the potential economic benefits the airport users would realize if the adverse effects of these weather situations on aircraft landings were completely eliminated by weather modification and/or electronic and other approach and landing aids. Specifically, the estimates which were developed and are shown in this part of the report are of the costs of disruptions (delays, diversions, and cancellations) of scheduled arrivals (landings) of aircraft of first and second level United States certificated route air carriers in domestic and international passenger service. This part of the report also includes a narrative discussion of the qualifications and limitations of the estimates, conclusions, and a bibliography. Author (GRA)

N72-22619* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MAGNETIC POSITION DETECTION METHOD AND APPARATUS Patent

John V. Foster, inventor (to NASA) Issued 30 Nov. 1971 17 p Filed 20 Jun. 1969

(NASA-Case-ARC-10179-1; US-Patent-3,624,598;

US-Patent-Appl-SN-835058; US-Patent-Class-340-26;

US-Patent-Class-244-114) Avail: US Patent Office CSCL 17G

A method and apparatus for establishing the position of an aircraft or other vehicle with reference to a predetermined set of coordinates is described. Magnetic fields are generated by long linear conductors and magnetic dipole means and the ratio of the fields created is measured at a given point to determine the distance between the sources and the given point. The electrical signals obtained by the apparatus are used to provide a visual display of the relative position of an aircraft to the runway upon which it is to land and/or a visual or audible indication of the aircraft's position relative to a predetermined glide slope.

Official Gazette of the U.S. Patent Office

N72-22620*# Litchford Systems, Northport, N.Y.

BROADCAST CONTROL OF AIR TRAFFIC Quarterly Report

George Litchford Mar. 1972 65 p refs

(Contract NASw-2247)

(NASA-CR-126157; QPR-3) Avail: NTIS CSCL 17G

Applications of wide range broadcast procedures to improve air traffic control and make more airspace available are discussed. A combination of the Omega navigation system and the very high frequency omnirange (VOR) is recommended as a means for accomplishing improved air traffic control. The benefits to be derived by commercial and general aviation are described. The air/ground communications aspects of the improved air traffic control system are explained. Research and development programs for implementing the broadcast concept are recommended. P.N.F.

N72-22621# Advisory Group for Aerospace Research and Development, Paris (France).

GUIDANCE AND CONTROL DISPLAYS

Feb. 1972 237 p refs Presented at 13th Meeting of Guidance and Control Panel of AGARD, Paris, 19-21 Oct. 1971

(AGARD-CP-96) Avail: NTIS

Conference papers are presented on guidance and control display design for aerospace vehicles. The particular areas of investigation are visual criteria, workload criteria, validation of design criteria, VTOL aircraft displays, displays for specific applications, new technology, and testing and evaluation of displays.

N72-22622# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Flight Deck Development Branch.

THE STATUS OF HUMAN PERCEPTUAL CHARACTERISTIC

DATA FOR ELECTRONIC FLIGHT DISPLAY DESIGN c05

Keith T. Burnett In AGARD Guidance and Control Displays Feb. 1972 10 p refs

Avail: NTIS

The human factors literature was searched and analyzed for human perceptual characteristic data relating to the design of individual electronic flight displays. Some of the more interesting data obtained are summarized and include flicker, visual acuity, display resolution, luminance, alphanumeric legibility, scale legibility, information coding, display size, and the effect of environmental variables on these quantities. Wherever possible the data are analyzed and presented so as to point out significant variables and data trends not specifically discussed in the original works. Author

N72-22623# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

A LIMITED STUDY OF THE TRADE OFF BETWEEN LUMINANCE AND COLOR CODING IN ELECTRONIC AIRCRAFT DISPLAYS c09

Ralf Beyer In AGARD Guidance and Control Displays Feb. 1972 9 p refs

Avail: NTIS

The effectiveness of luminance and color coding are compared as means for coding display elements in electronic displays. First a review of some past investigations is given. Next some experiments are described which contain an immediate-response task, a single-axis tracking experiment with discontinuous secondary task, tachistoscopic experiments, and the exploration of subjective judgements on different types of color coding in an experimental electronic display. In these experiments the only variable is the type of coding (luminance or color) used for the display elements and the various responses obtained are discussed. Author

N72-22624# Human Engineering Labs., Aberdeen Proving Ground, Md.

WHAT COLOR DISPLAY ELEMENT c05

John A. Barnes In AGARD Guidance and Control Displays Feb. 1972 11 p refs

Avail: NTIS

The results are presented of research directed toward determining the best possible colors to use for the elements of a multicolored aircraft display to insure a minimum number of instrument reading errors. A survey of the American manufacturers of multicolored mechanical aircraft displays provided a list of nine colors generally used as background colors and a like number of generally used pointer colors. An integrally illuminated test instrument was built which had the capability of presenting to a test subject any of these background and pointer colors in combination. The lighting of the test instrument was controlled at either of two illumination levels for each background color and was available, with this control, as a red lighting system or as a blue-white lighting system. These results provide the instrument manufacturers with twenty pointer and background combinations which can be expected to produce less than a one percent instrument scale reading error, regardless of the lighting system used and at illumination levels as low as .01 foot Lamberts. Author

N72-22625# Litton Systems, Inc., Van Nuys, Calif. Data Systems Div.

THE INTEGRATED COCKPIT PROCEDURE FOR IDENTIFYING CONTROL AND DISPLAY REQUIREMENTS OF AIRCRAFT IN ADVANCED TIME PERIODS c05

John V. Murphy and Bernard S. Gurman (ECOM, Fort Monmouth, N. J.) In AGARD Guidance and Control Displays Feb. 1972 7 p refs

Avail: NTIS

An adaptation of the integrated cockpit research procedure was used to define control and display requirements for the next generation utility transport helicopter under consideration by the U.S. Army. A control and display requirements analysis was conducted based upon the derivation of specific functions necessary for accomplishing four specified missions. Control/display mechanization was derived from specific mission functions. A time-based load analysis was performed utilizing computer processing techniques to make task adjustments in real time and provide a printout of how the tasks in each mission segment could be adjusted to meet the mission requirement. The technique also provided an analysis of contingency situations and denoted overload conditions that occurred. The hard copy mock-up was a full-scale cockpit shell in which the alternative mission control/display configurations could be illustrated. The mock-up contained realistic flight controls and audiovisual projector units that simulated vertical and horizontal situation display formats. Author

N72-22626# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

DESIGN IMPLICATIONS OF A BETTER VIEW OF THE MULTICHANNEL CAPACITY OF A PILOT c05

O. H. Lindquist *In* AGARD Guidance and Control Displays Feb. 1972 6 p refs

Avail: NTIS

A major result of a recently completed study is the prediction and measurement of multichannel pilot performance, which significantly increases his information-handling capability beyond that predicted by today's techniques. Current techniques of predicting man/machine interactions were shown to be in error by an order of magnitude in some measurements related to human channel capacity. The results of this experimental work are presented and system design implications for pilot capability and limitations are discussed. Author

N72-22630*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Lab.

INTEGRATED DISPLAY PRINCIPLES AND SOME APPLICATIONS TO V/STOL AIRCRAFT

Laurence R. Young *In* AGARD Guidance and Control Displays Feb. 1972 7 p refs

(Grant NGL-22-009-025)

(NASA-CR-126153) Avail: NTIS CSCL 01D

Design guidelines for pictorial integrated displays are presented, and include the display format and scaling based on expected flight path control requirements. The guidelines are illustrated by the bottom window predictor VTOL display, a perspective glide-slope contact analog V/STOL display, and an airborne air traffic situation display. Author

N72-22631# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).

EVALUATION OF AN INTEGRATED FLIGHT DISPLAY FOR THE MANUAL IFR-LANDING OF VTOL AIRCRAFT

H. J. Kornstaedt and J. Pfennigstorf *In* AGARD Guidance and Control Displays Feb. 1972 8 p refs

Avail: NTIS

An integrated flight display for the hovering phase of a VTOL landing was developed. The presentation of information to the pilot is evaluated in simulation by three criteria: landing performance, pilot rating, and measurement of the pilot's mental workload. Adaptation of the display dynamics and the desired landing-profile lead to higher level of performance at a decreased workload. Author

N72-22632# Ministry of Defence, London (England).

V/STOL DISPLAYS FOR APPROACH AND LANDING

David J. Walters and Ralf Beyer (DFVLR) *In* AGARD Guidance and Control Displays Feb. 1972 10 p

Avail: NTIS

The information requirements of a pilot carrying out a V/STOL approach and landing under adverse weather conditions are described, and solutions that were tried out experimentally are analyzed. Among the tentative conclusions are the following: (1) The amount of information needed for V/STOL displays and the independent motion in various axes pose problems in combining and integrating the information channels. It seems possible to combine both a horizontal and a vertical display in one format; the most difficult element to incorporate is the height information. (2) Most current displays were empirically designed without much regard for underlying principles. (3) An optimum cost effective mix of displays and controls appears to involve automatics for inner loop stabilization and displays with manual control for monitoring outer loop control. (4) Techniques of engineering displays for conventional flight appear adequate for V/STOL. Author

N72-22633# Ferranti, Ltd., Edinburgh (Scotland).

A NAVIGATION COMPUTER AND DISPLAY UNIT FOR HARRIER

Thomas S. Briggs *In* AGARD Guidance and Control Displays Feb. 1972 14 p refs

Avail: NTIS

The navigation display and computer for the Harrier strike aircraft is a compact, comprehensive, and self-contained navigation instrument. It contains a pictorial presentation of the navigational situation in the form of a projected moving map, together with the means of storing and selecting the coordinates of a number of destinations or fix points. A variety of numerical information such as latitude and longitude, time-to-go, and ground speed can be selected and displayed optically superimposed on the projected moving map. The display and computer contains all the facilities required for the management of the navigation aspects of the mission profile in one centralized area of the cockpit instrument panel. Particular attention is given to overcoming the viewing problems associated with the use of projected moving map displays in conditions of high ambient lighting, and to providing navigational control and operational facilities which are easy to use in practice. Author

N72-22634# Anacapa Sciences, Inc., Santa Barbara, Calif.

CONTEMPORARY MAP DISPLAYS

James J. McGrath *In* AGARD Guidance and Control Displays Feb. 1972 16 p refs

Avail: NTIS

A general review of developments and capabilities in airborne map display systems is presented. A brief overview of the complicated history of research, development, and operational use is presented first, and then the development of each of four basic types of map displays is traced from its origin to its present status. The four types are: direct-view map displays, projected map displays, combined map/CRT displays, and electronically generated map displays. The main advantages and limitations of each type are noted, and the various ways in which the basic design concepts have been implemented are described. A number of design issues and operational problems of current importance are identified and briefly discussed. Author

N72-22635# Smiths Industries Ltd., Bishops Cleeve (England). Aviation Div.

THE IMPACT OF ADVANCING TECHNOLOGY ON THE EVOLUTION OF ELECTRONIC HEAD-UP DISPLAY SYSTEMS

John H. Smith *In* AGARD Guidance and Control Displays
Feb. 1972 10 p
Avail: NTIS

The history of electronic head-up display system as applied to military aircraft is outlined. The various major developments demanded by successive avionic system requirements, and the way in which advancing technology, mainly in the area of components, allows these increasingly stringent requirements to be implemented are discussed. The main emphasis is on the engineering and hardware aspects, and systems fitted to current production aircraft such as the Harrier are discussed. Reference is also made to the most recent developments where computation for weapon delivery, or other purposes, can be provided as an integral facility within the electronics unit. Author

N72-22636# Elliott Flight Automation, Ltd., Rochester (England). Airport Works.

SOME ENGINEERING AND OPERATIONAL FACTORS OF MULTISENSOR DISPLAYS

P. A. Hearne and D. W. Hussey *In* AGARD Guidance and Control Displays Feb. 1972 14 p
Avail: NTIS

The operational advantages of presenting a range of complementary data to the aircrew from which they can make improved deductive judgements is briefly discussed and some operational requirements are outlined. The engineering solutions are shown to favor a raster based display which can accommodate both computed and sensor data in the same format. Methods of display computation and scan conversion associated with this raster technique are described and typical displays produced by these methods are illustrated. Author

N72-22637# Compagnie Generale de Telegraphie sans Fil, Paris (France). Div. des Equipments Avioniques et Spatiaux.

INTEGRAL COMMAND AND CONTROL SYSTEM FOR AIRCRAFT [SYSTEME INTEGRE DE CONTROLE ET DE COMMANDE DES AVIONS]

Marie-Jacques Jullien *In* AGARD Guidance and Control Displays Feb. 1972 12 p *In* FRENCH

Avail: NTIS

Operating characteristics and techniques are presented for an aircraft integrated command and control system. The system is designed to ease the primary tasks of pilots in the coming years, tasks which have become increasingly difficult due to machine complexity and steadily growing air traffic density.

Transl. by K.P.D.

N72-22639# Farrand Optical Co., Inc., Valhalla, N.Y.

A MULTIPURPOSE WIDE FIELD, THREE DIMENSIONAL HEAD UP DISPLAY FOR AIRCRAFT

Joseph A. LaRussa *In* AGARD Guidance and Control Displays Feb. 1972 10 p ref
Avail: NTIS

A system useful to pilots for approach and landing and for navigation is described. Attitude, airspeed, altitude, and spatial location as derived both from analog display which is projected through the windscreen and superimposed on the real world view. The display is a three-dimensional roadway in the sky, down which the aircraft can be flown either for navigation or to a touchdown on the runway. The roadway may also be used to define a holding pattern or even a complete route from takeoff to touchdown. The three-dimensional analog display reduces pilot interpretation time and thereby provides for better aircraft control. Author

N72-22640# Motorola, Inc., Scottsdale, Ariz.

A TRUE 3D OR FLAT 2D DISPLAY

Jordon D. Lewis (Battelle Develop. Corp.) and George P. Walling

In AGARD Guidance and Control Displays Feb. 1972 6 p refs

Avail: NTIS

A display principle is described for a true 3-D display or a multicolor, solid state, flat panel display. The display volume or surface is a transparent material in which an isolated moving spot is created. Arbitrary 2-D or 3-D figures are generated by rapidly moving the spot in two or three dimensions refreshed at a sufficient rate to eliminate flicker. Data may be entered from conventional sources into the refresh memory, and manual interaction via a movable cursor is possible. The advantages of presenting 3-D information in a true 3-D format are discussed, and applications to display clutter reduction are described. The requirement for a compact, flat panel cockpit display is directly addressed. Author

N72-22641# Singer-Kearfott, Little Falls, N.J.

SPACE TECHNOLOGY APPLICATIONS TO GUIDANCE AND CONTROL DISPLAYS

Joseph Koprowski *In* AGARD Guidance and Control Displays Feb. 1972 11 p refs
Avail: NTIS

Spacecraft displays with their need for small size, low weight, low power consumption, and high reliability have required all solid state digital displays using electroluminescent or light-emitting diode illumination techniques. Advanced integrated circuit electronics, novel mechanical packaging techniques, and high-reliability assurance programs are used in these displays. These technologies, and several existing and other under-development aerospace displays and control units utilizing these technologies are reviewed. Author

N72-22642# Anacapa Sciences, Inc., Santa Barbara, Calif.

UTILITY OF THE VERTICAL CONTACT ANALOG DISPLAY FOR CARRIER LANDINGS: A DIAGNOSTIC EVALUATION

Kenneth D. Cross and Frank R. Cavallero (Naval Missile Center) *In* AGARD Guidance and Control Displays Feb. 1972 11 p refs
(ONR Proj. 0-0077; JNR Proj. 0-0078; ONR Proj. 0-0079)
Avail: NTIS

The accuracy of the pictorial vertical situation display generated by a digital computer was evaluated. Position and attitude errors were measured under each of five experimental conditions, a full-scale simulated carrier landing task and four part-tasks. The part-tasks were designed to assess the degree to which display resolution, temporal loading, and control complexity contribute to total system error. All three attitude parameters were controlled with a high degree of accuracy under all conditions. Control of vertical and lateral position in the full-scale simulation condition was accomplished with about the same accuracy and precision as that reported for actual (day) carrier landings in F-4 aircraft. The part-task data revealed that the largest contributor to lateral error was control complexity, whereas display resolution and temporal loading were found to be large and roughly equivalent contributors to vertical error. Author

N72-22643# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Flight Deck Development Branch.

RATE OF CLOSURE AS A PERFORMANCE AS A PERFORMANCE MONITORING PARAMETER

Eldon M. Bobbett and Kenneth R. Woodruff (Sys. Res. Labs., Inc., Dayton, Ohio) *In* AGARD Guidance and Control Displays Feb. 1972 11 p refs
Avail: NTIS

Surveys on approach and landing accidents revealed the need for rate-of-closure information. Presenting the information and subjecting it to operational criticism were accomplished with a simulation evaluation of a modified Attitude Director Indicator (ADI) incorporating the rate-of-closure information, a two phase flight test evaluation of the same indicator, and a simulation

evaluation of a cathode ray tube ADI with rate-of-closure information presented similarly to how it is presented in the electromechanical ADI. The results are explicit in that rate-of-closure information is a requirement in the approach and landing modes and does a good job as a performance monitoring parameter. Author

N72-22644# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Flight Deck Development Branch.
THE ELECTROLUMINESCENT LIGHTING RESEARCH PROGRAM

David L. Turney and Leroy Addis (Lear Siegler, Inc., Grand Rapids, Mich.) In AGARD Guidance and Control Displays Feb. 1972 11 p refs

Avail: NTIS

Experiments flown in a T-39 aircraft by experienced pilots were designed to simulate different types of operational flights by progressively increasing the external visual task loading on the pilot. Both objective measurements and pilot opinion data were obtained on display illumination under external ambient illumination ranging from twilight to night no-moon conditions. Photometric data showed that the pilot's display lighting requirements were influenced by the outside illumination only when this illumination exceeded .001 foot candles. When the night illumination fell below this level, display illumination was primarily influenced by the pilot's preflight dark adaptation; the type of information required for successful mission completion; the priority the pilot placed on the information available; and the effects of cockpit lighting on display legibility. Author

N72-22646# Federal Aviation Administration, Washington, D.C. Aviation Forecast Div.

IFR AIRCRAFT HANDLED FORECAST BY AIR ROUTE TRAFFIC CONTROL CENTER, 1972-1983

Jan. 1972 42 p ref

(Rept-72-00186) Avail: NTIS

Forecasts of IFR aircraft handled by FAA air route traffic control centers (ARTCC) are presented. It serves as an aid to the FAA planning and budget functions in determining future requirements for facilities, equipment, and manpower. Forecasts of aircraft handled in air carrier, general aviation, and military categories are included for Fiscal Years 1972 through 1978 and 1982 and 1983 for ARTCC's in each of the eleven FAA regions. The forecast employs as a base the national forecast of IFR aircraft handled as developed for the FAA report Aviation Forecasts, Fiscal Years 1972-83. Historical trends of each ARTCC are extrapolated and adjustments made for known alterations in center boundaries. Author

N72-22648*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIGITAL SIMULATION OF CONTINUOUS ERROR MODELS WITH APPLICATION TO AN INSTRUMENT LANDING SYSTEM ERROR

Robert B. Merrick and Gerald L. Smith Mar. 1972 21 p refs (NASA-TM-X-62116) Avail: NTIS CSCL 17G

A digital simulation of the continuous error of the localized beam of a conventional instrument landing system is discussed. The digital simulation was developed during the analysis of space shuttle navigation capabilities. A discrete mathematical model for use on a digital computer is described. The model generates an output random sequence which is equivalent, for simulation purposes, to the desired random process. The model is a system of difference equations driven by a zero-mean Gaussian random sequence. Author

N72-22649# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATC SURVEILLANCE/COMMUNICATION ANALYSIS AND PLANNING: TRANSPONDER TEST PROGRAM Final Report

G. V. Colby and E. A. Crocker 12 Apr. 1972 72 p refs (Contracts DOT-FA72WAI-242; Proj. 034-241-012; F19628-70-C-0230)

(FAA-RD-72-30; ATC-9) Avail: NTIS

Performance parameters of transponders installed in aircraft were measured to determine their degree of compliance with current specifications. A mobile van was outfitted with electronic test equipment which simulated the transmitter and receiver sections of a ground interrogator and which allowed measurement of transponder parameters. A horn antenna located near the aircraft under test was used to couple signals to and from the transponder. The results of measurements on 504 transponders installed in general aviation aircraft, 17 transponders installed in military aircraft, and 28 transponders installed in air carrier aircraft are reported. Of these, 31 general aviation, 2 military, and one air carrier transponders were inoperative. The results of measurements of reply frequency, squitter, delay Mode C operation, dead time, P2/P1 ratio required for suppression, suppression time, framing pulse spacing, power output and sensitivity are included. Author

N72-22651*# Systems Technology, Inc., Hawthorne, Calif.
DETERMINATION OF ILS CATEGORY 2 DECISION HEIGHT WINDOW REQUIREMENTS

Walter A. Johnson and Roger H. Hoh Washington NASA May 1972 69 p refs

(Contract NAS2-4892)

(NASA-CR-2024; TR-182-4) Avail: NTIS CSCL 01E

A method for determining the appropriate longitudinal and lateral decision height dispersion limits for any airplane/control system combination during an instrument landing approach is presented. An example is worked out to clarify the steps required. It is shown that the current longitudinal decision height dispersion limits are well suited for a DC-8 with the example control system, but that the lateral limits are too loose to guarantee acceptable touchdowns with the example system subjected to recommended wind and shear disturbances. Author

N72-22652*# Systems Technology, Inc., Hawthorne, Calif.
DEVELOPMENT OF APPROACH CONTROL SYSTEM REQUIREMENTS WITH APPLICATIONS TO A JET TRANSPORT

Duane T. McRuer and Walter A. Johnson Washington NASA May 1972 67 p refs

(Contract NAS2-4892)

(NASA-CR-2023; TR-182-3) Avail: NTIS CSCL 01E

The development of requirements for an approach control system and example applications to a jet transport aircraft are presented. The material is divided into a general discussion of approach control requirements, and a specific application resulting in the design of three alternative longitudinal controllers. The point of view taken is that the essential features of the system structure are the feedbacks themselves, their equalization, and their combinations to create control commands. Use is made of the fact that for successful systems the possible feedback structures are very limited. They derive primarily from guidance, control, and regulation demands; and secondarily from dynamic response characteristics desired by the pilot. From the systems view it is the satisfaction of these requirements that is important rather than the means automatic, manual, or hybrid manual/automatic approach systems. Author

N72-22653# Transportation Systems Center, Cambridge, Mass.
THE ILS SCATTERING PROBLEM AND SIGNAL DETECTION MODEL

G. Chin, L. Jordan, D. Kahn, and S. Morin Feb. 1972 105 p refs

(DOT-TSC-FAA-72-7) Avail: NTIS

The construction of a mathematical model of the instrument landing system (ILS) multipath problem has been undertaken. The theoretical basis for any such model, a critique of previous models and newly achieved developments in ILS model construction are presented. Author

N72-22655# TRW Systems Group, Redondo Beach, Calif.

NUCLEAR INSTRUMENT LANDING SYSTEMS Phase 1

Final Report, Sep. 1970 - Jun. 1971

R. A. Kaminskas 2 Oct. 1971 110 p refs

(Contract AT(04-3)-828)

(SAN-828-1) Avail: NTIS

Development of the nuclear instrument landing system for providing highly accurate aircraft position information during the last phases of descent and touchdown is described. The system consists of beacons of radioisotope gamma sources which are permanently installed at the airport and airborne equipment which consists of scintillation detectors and associated electronics. Author (NSA)

N72-22657# Lincoln Lab., Mass. Inst. of Tech., Lexington.

AIR TRAFFIC CONTROL Quarterly Technical Summary,

1 Aug. - 31 Oct. 1971

Herbert G. Weiss 15 Nov. 1971 13 p

(Contract F19628-70-C-0230; AF Proj. 649L)

(AD-735322; ESD-TR-71-303) Avail: NTIS CSCL 17/7

Contents: ATC radar beacon system development; MTI studies; Airborne traffic situation display--Design studies, Display simulation, Cost benefit analysis; Communications, navigation, and identification system; Microwave landing guidance systems. GRA

N72-22659# Tracor, Inc., Austin, Tex.

INVESTIGATION OF ANTENNA DUMPING AS A MEANS OF REDUCING PRECIPITATION INTERFERENCE IN AIRBORNE OMEGA Final Report

O. J. Baltzer Jan. 1972 20 p refs

(Contract DOT-FA67WAI-134)

(AD-736516; T71-AU-9279-U; FAA-RD-72-1) Avail: NTIS CSCL 17/7

Omnidirectional E-field antennas (e.g., whip, blade, and long-wire antennas) have various practical advantages over crossed-loop antennas in airborne Omega; however, experience has shown that E-field antennas are much more susceptible to precipitation static. The author has proposed that the interference effects of p-static upon E-field antennas might be reduced by periodically discharging (dumping) any accumulated voltage present on the antenna. The duration of each discharge would be extremely short (typically 0.1 microsecond); on this basis it was hypothesized that the electric field due to propagated electromagnetic signals (Omega) and the electrostatic field associated with p-static would show different recovery characteristics; with the radiative field recovering essentially instantaneously. Author (GRA)

N72-22662# National Aviation Facilities Experimental Center, Atlantic City, N.J.

INVESTIGATE INCOMPATIBILITY BETWEEN GROUND AND AIRBORNE MEASUREMENTS OF VOR SPACE MODULATION Final Report, Jul. 1970 - Mar. 1971

Matthew Naimo, Jr. Feb. 1972 63 p refs

(FAA Proj. 041-305-05)

(AD-737039; FAA-NA-72-18; FAA-RD-71-119) Avail: NTIS CSCL 17/7

The report describes an investigation into the cause of incompatibility between ground and airborne measurements of VOR space modulation when using the latest flight inspection receiver, Fa-4165 3-A. The effort included a survey of the existing procedures and equipment used throughout the FAA, an evaluation of the ground measurement technique, and an evaluation of the airborne measurement technique. The result of the investigation identified problem areas with both the ground and airborne techniques. Author (GRA)

N72-22663# National Aviation Facilities Experimental Center, Atlantic City, N.J.

INVESTIGATE AND ANALYZE DME TRAFFIC LOAD Final Report, Mar. 1970 - May 1971

George J. Hartranft and Harold Postel Feb. 1972 30 p

(FAA Proj. 330-006-07X)

(AD-737038; FAA-NA-72-24; FAA-RD-71-109) Avail: NTIS CSCL 17/7

The report covers the development of a method of measuring DME traffic for both a DME-saturated and non-saturated Tacan site. DME traffic counts were conducted at the following Eastern Region VORTACs: LaGuardia, Robbinsville, Coyle, Kenton, Deer Park, Sea Isle, and Yardley. The LaGuardia VORTAC experienced the highest peak traffic of the VORTACs tested. The LaGuardia traffic count indicates the system is operating at 66 percent of full-load capacity during peak traffic. Author (GRA)

N72-22791*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.

SINGLE-STAGE EXPERIMENTAL EVALUATION OF COMPRESSOR BLADING WITH SLOTS AND VORTEX GENERATORS, PART 5 Final Report

J. A. Brent 31 Mar. 1972 135 p refs

(Contract NAS3-10481)

(NASA-CR-72793; PWA-FR-4541-Pt-5) Avail: NTIS CSCL 21E

An experimental investigation was conducted to determine the extent that slots and vortex generators can increase the efficiency and stable operating range of highly loaded compressor stages. With slots in the rotor and stator, the stage performance both with and without vortex generators was inferior to that achieved with the unslotted blading. However, with vortex generators, stator slots, and an unslotted rotor, the stable operating range increased 25% and the stage peak efficiency increased 2.1% over the values achieved with the unslotted rotor and stator without vortex generators, at design equivalent rotor speed. Author

N72-22792*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.

DEVELOPMENT OF A SHORT LENGTH COMBUSTOR FOR A SUPERSONIC CRUISE TURBOFAN ENGINE USING A 90 DEG SECTOR OF A FULL ANNULUS Interim Report, Apr. 1970 - Aug. 1971

T. R. Clements Apr. 1972 45 p refs

(Contract NAS3-11159)

(NASA-CR-120908; PWA-FR-4854; IR-2) Avail: NTIS CSCL 21H

A performance development program has been conducted on a short length, double-annular, ram-induction combustor. The combustor was designed for a large augmented turbofan engine capable of sustained flight speeds up to Mach 3.0. Performance tests were conducted at an inlet temperature and Mach number simulating engine sea level takeoff conditions. At the design temperature rise of 1600 F, combustion efficiency was 100%, pattern factor was 0.20, and combined diffuser-combustor pressure loss was 4.4% or 1.12 times the diffuser inlet velocity head. A temperature rise in excess of 2400 F with a combustion efficiency of 94% was demonstrated. Author

N72-22795*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF THE EFFECT OF ENGINE CHARACTERISTICS ON THE EXTERNAL AERODYNAMICS OF STOL WING PROPULSION SYSTEMS

James A. Albers Washington Apr. 1972 19 p refs (NASA-TM-X-2541; E-6757) Avail: NTIS CSCL 21E

The effects of engine pressure ratio, engine size, and engine location on the pressure distribution, lift coefficient, and flow field of a STOL wing propulsion system are presented. The flow variables of the engines are included in the two-dimensional potential flow analysis by considering the effects of mass flow coefficient at the engine inlet and thrust coefficient at the engine exit. A functional relation between these coefficients and engine pressure ratio is given. The results of this study indicate that the effect of engine pressure ratio on the external aerodynamics is a function of engine location. For engines located on the bottom of the wing, the highest pressure ratio engine resulted in the highest lift coefficient. For engines located on the top of the wing, the lowest pressure ratio engine resulted in the highest lift coefficient.

Author

N72-22798# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

GAS TURBINE CYCLE CALCULATIONS: EXPERIMENTAL VERIFICATION OF OFF-DESIGN-POINT PERFORMANCE PREDICTIONS FOR A TWO-SPOOL TURBOJET WITH VARIOUS AIR BLEEDS

M. S. Chappell and W. Grabe Nov. 1971 76 p refs (LR-555; NRC-12475) Avail: NTIS

A simplified method for calculating off-design-point performance of turbojet and turbofan engines, both at sea level and at altitude conditions, is presented. The method implies constancy of component efficiencies and linearity of corrected mass flow with corrected engine speed. Data were gathered on a j-75 two spool turbojet engine at part throttle conditions, with compressor bleed extraction, and with propelling nozzle area change. The calculations were found to be accurate for part throttle performance, but less successful for the other conditions.

Author

N72-22799*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF THE EFFECT OF TWO DAMPER SIZES ON THE PERFORMANCE OF A LOW-SOLIDITY AXIAL-FLOW TRANSONIC COMPRESSOR ROTOR

George W. Lewis, Jr. and Donald C. Urasek Washington Apr. 1972 89 p refs (NASA-TM-X-2536; E-6536) Avail: NTIS CSCL 21E

The experimental performance of a 20-inch-diameter axial-flow transonic compressor rotor with small dampers is presented. The compressor rotor was tested earlier with large dampers which were twice in size, and comparisons of overall performance and radial distributions of selected flow and performance parameters are made. The rotor with small dampers experienced lower losses in the damper region which resulted in locally higher values of temperature rise efficiency and total pressure ratio. However, there was no appreciable effect on overall efficiency and pressure ratio. A greater stall margin was measured for the rotor with small dampers at design speed, but at 70 and 90 percent of design speed the rotor with large dampers had somewhat greater flow range.

Author

N72-22918# Advisory Group for Aerospace Research and Development, Paris (France).

THE ACCUMULATION OF FATIGUE DAMAGE IN AIRCRAFT MATERIALS AND STRUCTURES

J. Schijve (Natl. Aerospace Lab., Amsterdam) Jan. 1972 125 p refs (AGARD-AG-157; AGARDograph-157) Avail: NTIS

The available literature in the field of fatigue damage accumulation is surveyed and analyzed. Physical aspects of fatigue damage accumulation are discussed, including interaction and sequence effects. Empirical trends observed in variable-amplitude tests are summarized including the effects of a high preload, periodical high loads, ground-to-air cycles and the variables pertaining to program loading, random loading and flight-simulation loading. This also includes results from full-scale fatigue test series. Various theories on fatigue damage accumulation are recapitulated. The significance of these theories for explaining empirical trends as well as for estimating fatigue properties as a design problem is evaluated. For the latter purpose reference is made to the merits of employing experience from previous designs. Fatigue testing procedures are discussed in relation to various testing purposes. Emphasis is on flight-simulation tests. Finally several recommendations for further work are made.

Author

N72-22968# Federal Aviation Administration, Washington, D.C. Office of Aviation Economics.

POTENTIAL FOREIGN MARKET FOR THE SALE OF SURPLUS US JET TRANSPORTS

Dec. 1971 12 p refs (Rept-72-00185) Avail: NTIS

A potential foreign market is identified for 167 four-engine jet transports through 1972 and 22 two-engine jets, making a total market of 189 jets. Two-engine jets were considered generally as a replacement for Viscounts. The potential market and requirements by foreign airlines are summarized

Author

N72-22969# Air Transport Association of America, Washington, D.C.

CANADA DURING THE AIR TRAFFIC CONTROLLERS STRIKE: WHAT IT'S LIKE WHEN A COUNTRY LOSES ITS AIR TRANSPORTATION Air Transport Report

William E. Jackman Feb. 1972 18 p Avail: NTIS

The transportation problems caused by Canadian air traffic controller's strike are outlined. The strike cut out air mail service, all commercial and reduced military air transportation, caused critical shortages in available vegetable and fruit markets, severe shortage in available flowers, and traveling difficulties for conventions being held in Canada. Besides critical shortages in bus and rail services, the strike caused higher prices for food and other services, adverse sentiments in Parliament, and loss of support in the general population.

E.H.W.

N72-22973# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

[AEROSPACE FUNDAMENTAL AND APPLIED RESEARCH] Annual Progress Report, 1971

Dec. 1971 193 p refs Original contains color illustrations Avail: NTIS

Abstracts and summaries are presented of research conducted during 1971. Areas of investigation include the following: (1) mechanics of rarefied gases; (2) plasma dynamics; (3) compressible flows, shock wave phenomena, and hypersonic gasdynamics; (4) MHD power generation and remote sensing; (5) aerodynamic noise; (6) subsonic aerodynamics; (7) space dynamics; (8) materials science and structures; (9) rocket research; (10) space simulation, surface interactions, and trace gas analysis; (11) air cushion technology; (12) laser excitation, diagnostics, and environmental sensing; (13) flight transportation; (14) aerospace optical image processing; (15) sonic boom; and (16) industrial and architectural aerodynamics.

D.L.G.

N72-22980*# Boeing Co., Seattle, Wash.

STUDY OF AN INTRAURBAN TRAVEL DEMAND MODEL INCORPORATING COMMUTER PREFERENCE VARIABLES

Paul E. Holligan, Malcolm A. Coote, Charles R. Rushmer, and Michael L. Fanning Dec. 1971 342 p refs
(Contract NAS2-5969)
(NASA-CR-114418; D6-40556) Avail: NTIS CSCL 13F

The model is based on the substantial travel data base for the nine-county San Francisco Bay Area, provided by the Metropolitan Transportation Commission. The model is of the abstract type, and makes use of commuter attitudes towards modes and simple demographic characteristics of zones in a region to predict interzonal travel by mode for the region. A characterization of the STOL/VTOL mode was extrapolated by means of a subjective comparison of its expected characteristics with those of modes characterized by the survey. Predictions of STOL demand were made for the Bay Area and an aircraft network was developed to serve this demand. When this aircraft system is compared to the base case system, the demand for STOL service has increased five fold and the resulting economics show considerable benefit from the increased scale of operations. In the previous study all systems required subsidy in varying amounts. The new system shows a substantial profit at an average fare of \$3.55 per trip. Author

N72-22986# Department of Transportation, Washington, D.C. Office of Systems Analysis and Information.

RECOMMENDATIONS FOR NORTHEAST CORRIDOR TRANSPORTATION. VOLUME 3: APPENDICES Final Report, Apr. 1970 - Sep. 1971

Myron Miller, Melvyn Cheslow, Nancy T. Ebersole, John Gerba, Donald J. Igo, Walter Velona, and Robert L. Winestone Sep. 1971 217 p refs 3 Vol.

(PB-205243) Avail: NTIS CSCL 13B

Descriptions are presented of methodology and detailed results of the Northeast Corridor's air and highway systems analysis and general environmental forecasts through 1985.

GRA

N72-22991 Georgia Inst. of Tech., Atlanta.

AN INVESTIGATION OF NEAR WAKE EFFECTS IN AIRFOIL DYNAMIC STALL Ph.D. Thesis

Roy Mac Scruggs 1971 203 p

Avail: Univ. Microfilms Order No. 71-20365

A combined analytical and experimental investigation is performed to evaluate near wake effects on airfoil loading in dynamic stall and to study the wake structure resulting from oscillatory motion of a stalled airfoil. A central objective of the work is to establish the importance of wake Strouhal resonance as it relates to the time dependent loading of the airfoil and the establishment of wake coherency. An analytical model is developed using a flat plate approximation and based on the assumption of circulation preserving flow, after due allowance for loss of bound circulation in steady or mean stall. The model demonstrates, through abrupt release of discrete vortices from leading and trailing edges, the type of behavior observed experimentally for the time dependent loading of a dynamically stalled airfoil. It further indicates that decreasing vortex propagation velocity, with all other parameters fixed, tends to be destabilizing to the airfoil pitch motion. Dissert. Abstr.

N72-22992 Illinois Univ., Urbana.

THEORETICAL DETERMINATION OF THE PRESSURE DISTRIBUTION ON A LIFTING, SUBSONIC DELTA WING OF ARBITRARY ASPECT RATIO Ph.D. Thesis

Carl Eugene Swain 1971 116 p

Avail: Univ. Microfilms Order No. 71-21245

The subsonic, plane delta wing problem is solved by use of linearized lifting surface theory. The pressure distribution on the wing surface is expressed as a particular series of Tchebycheff polynomials of the first and second kinds whose arguments are functions of both the spanwise and the chordwise variables. The tangential flow boundary condition, which must be imposed upon the lifting-surface integral equation, is satisfied by use of Flax's variational principle. The use of this variational principle

allows the unknown coefficients in the pressure distribution series to be determined from a set of linear algebraic equations.

Dissert. Abstr.

N72-22993*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF TRANSIENT WINDS ON THE FLOW QUALITY OF AN OPEN-CIRCUIT WIND-TUNNEL MODEL

Douglas C. Breunlin and Noel B. Sargent Washington Apr. 1972 24 p refs

(NASA-TM-X-2538; E-6773) Avail: NTIS HC \$3.00 CSCL 01A

The effect of a transient wind on the test-section flow quality of an open-circuit wind tunnel was investigated experimentally. The investigation was restricted to transient wind effects associated with the inlet. A small open-circuit wind tunnel was placed outside in the real wind environment. Test-section speed and angularity as well as wind speed and direction was measured by high-response instrumentation. The inlet configuration was varied with a set of screens, a removable honeycomb, and a removable inlet lip. Acceptable flow was obtained at all wind angles and for wind- to test-section-velocity ratios up to 0.4 with an inlet configuration having five screens, a honeycomb, and a lip. With inlet configurations sensitive to winds, a transient wind parallel to the tunnel axis produced local fluctuations in test-section speed and angularity; however, oscillation of the average test-section speed was not evident. The effect of wind direction was negligible up to wind angles of 45 deg relative to the tunnel axis. At larger wind angles, flow distortions occurred primarily on the windward side of the test section. Author

N72-22994*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECTS OF CASING BOUNDARY-LAYER REMOVAL ON NOISE OF A TURBOFAN ROTOR

Arthur W. Goldstein, Frederick W. Glaser, and James W. Coates Washington Apr. 1972 40 p refs

(NASA-TN-D-6763; E-6727) Avail: NTIS HC \$3.00 CSCL 01A

The effect of casing boundary-layer removal on noise produced by a turbofan rotor was measured. The outlet guide vanes were removed for these tests. A comparison was made between the noise measurements when the boundary layer was bled off and under zero bleed conditions. When the boundary layer was removed, overall sound pressure level was reduced 2 dB with moderate blade loading and 3 dB with heavier blade loading. An analysis of the changes in the spectral density with bleed is presented. Author

N72-22995*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NONPLANAR METHOD FOR PREDICTING INCOMPRESSIBLE AERODYNAMIC COEFFICIENTS OF RECTANGULAR WINGS WITH CIRCULAR-ARC CAMBER Ph.D. Thesis - Virginia Polytechnic Institute

John Everett Lamar Dec. 1971 94 p refs

(NASA-TM-X-67791) Avail: NTIS HC \$6.75 CSCL 01A

The development of a nonplanar lifting surface method having a continuous distribution of singularities and satisfying the tangent flow boundary condition on the mean camber surface is given. The method predicts some incompressible longitudinal aerodynamic coefficients of rectangular wings which have circular-arc camber. The solution method is of the integral-equation type and the resulting surface integrals are evaluated by either using numerical or analytical techniques, as are appropriate. Applications are made and the results compared with those from an exact two-dimensional circular-arc camber solution, a three-dimensional flat-wing solution which represents the camber by a projected slope onto the flat surface, and a flat-wing experiment. From these comparisons, the present method is found to predict well the flat-wing experiment and limiting values, in addition to the center of pressure variation at an angle of attack of zero for any camber. For wings having camber ratios larger than about 1.25% and moderate to high aspect ratios, the results deteriorate due to the inadequacy of lifting pressure modes employed. Author

N72-22997# Boeing Co., Renton, Wash. Commercial Airplane Group.

STUDY COVERING CALCULATIONS AND ANALYSIS OF SONIC BOOM DURING OPERATIONAL MANEUVERS. VOLUME 3: DESCRIPTION OF COMPUTER PROGRAM, SONIC BOOM PROPAGATION IN A STRATIFIED ATMOSPHERE, AND ESTIMATION OF LIMITATION NEAR CAUSTICS Final Report, Apr. 1970 - Feb. 1971

G. T. Haglund and D. L. Olson Feb. 1971 294 p refs

(Contract DOT-FA70WA-2315)

(AD-735297; D6-A-12108-3-Vol-3; FAA-EQ-71-2-Vol-2) Avail: NTIS CSCL 01/2

The methods and results of the study of the effects of operational SST maneuvers on sonic boom are contained in three volumes. Volume III describes the computer program, sonic boom propagation in a stratified atmosphere, written in FORTRAN IV for processing on an IBM 7090 or CDC 6600 and plotting on a CalComp digital incremental plotter. It provides the capability to calculate sonic boom pressure signatures generated by arbitrary maneuvering airplanes in horizontally stratified atmospheres with wind. Author (GRA)

N72-22999# Boeing Co., Philadelphia, Pa. Vertol Div. **WIND TUNNEL TEST OF THE CONVERSION PROCESS OF A FOLDING TILT ROTOR AIRCRAFT USING A SEMISPAN UNPOWERED MODEL VOLUME 4, PART 1: ANALYSIS AND RESULTS** Final Report

John Magee and Robert B. Taylor Wright-Patterson AFB, Ohio AFFDL Aug. 1971 140 p refs

(Contract F33615-69-C-1577)

(AD-735632; D213-10000-4-Vol-4-Pt-1;

AFFDL-TR-71-62-Vol-4-Rt-1) Avail: NTIS CSCL 01/3

Wind tunnel test data obtained with a 33.75 inch diameter nonarticulated folding tilt rotor mounted on a semispan wing show the effects of collective pitch schedule variations on transient lift, drag, and pitching moment of the aircraft. Blade loads data presented show that loads do not limit the conversion process. The model was configured with prop/rotor blades which had an in-plane natural frequency of less than 1.0/rev. The testing included study of the aerodynamics and dynamics of rotor spin-up, spin-down, stopping, and steady windmilling. Correlation with predictions of transient aerodynamic performance static derivatives of the prop/rotor, and blade loads are included.

Author (GRA)

N72-23000# Boeing Co., Philadelphia, Pa. Vertol Div. **WIND TUNNEL TEST OF A POWERED TILT-ROTOR DYNAMIC MODEL ON A SIMULATED FREE FLIGHT SUSPENSION SYSTEM, VOLUME 6** Final Report, Jan. - Jul. 1971

John E. Tomassoni, Robert B. Taylor, Leon N. Delarm, and Edward B. Schagrin Wright-Patterson AFB, Ohio AFFDL Oct. 1971 210 p refs

(Contract F33615-69-C-1577)

(AD-735633; D213-10000-6-Vol-6; AFFDL-TR-71-62-Vol-6)

Avail: NTIS CSCL 01/3

The report presents the results of a wind tunnel test on a powered dynamic model of the Boeing M-160 tilt rotor aircraft with 5.5 foot diameter rotors. The model was tested in the Boeing V/STOL 20 x 20 foot wind tunnel during January - February 1971 and was supported to simulate free flight conditions with mount frequencies much lower than the dynamic aircraft frequencies. Blade loads, wing loads, flying qualities and skittishness in ground effect data were obtained. Author (GRA)

N72-23002# Douglas Aircraft Co., Inc., Long Beach, Calif. **INVESTIGATION OF AERODYNAMIC ANALYSIS PROBLEMS IN TRANSONIC MANEUVERING, VOLUME 1** Final Report, Jun. 1970 - Aug. 1971

Arvel E. Gentry and Wayne R. Oliver Sep. 1971 264 p refs (Contract N00014-70-C-0400; NR Proj. 212-199)

(AD-737293; MDC-J5264-01-Vol-1) Avail: NTIS CSCL 20/4

This report describes the results of a study into the general problems of the aerodynamic analysis of airfoils and wings at transonic flight conditions. The basic guideline of this study was to assess, analyze and interpret the various methods available and to explore their further development where possible. The general aspects of the transonic maneuvering problem were reviewed. Particular emphasis was placed on methods for the analysis of airfoils leading to buffet onset prediction. This program includes a potential flow analysis, supercritical pressure calculations, and boundary layer calculation using either a finite-difference method or an integral method. Methods available for predicting pressures on three-dimensional wings are also compared.

Author (GRA)

N72-23003 Delaware Univ., Newark.

AN EXPERIMENTAL STUDY OF SUBSONIC JET NOISE AND A METHOD FOR LOW FREQUENCY REDUCTION Ph.D. Thesis.

Walter Zane Collings 1970 333 p

Avail: Univ. Microfilms Order No. 71-17932

The fundamentals of jet noise generation and suppression are reviewed. The noise field of a one inch diameter subsonic air jet was investigated and a method for low frequency reduction evaluated. The Mach number range was from 0.55 to 1.0. The wide-band noise measurements cover the frequency range from 250 Hz to 18,000 Hz and noise spectra were analyzed in 1/3-octave bands. The airflow system and noise measuring system are described. The errors associated with taking measurements within an enclosed room are considered, as well as the method used to establish the approximate field conditions. For the simple jet, the directionality of the wide-band levels and spectrum levels are shown. The power law dependence of both wide-band and spectrum sound pressures on velocity is determined. Comparisons are made with theory and previous work. The measurements confirm the main points of the theory, namely, convected quadrupole radiation. Dissert. Abstr.

N72-23004 Cornell Univ., Ithaca, N.Y.

THE EFFECT OF ATMOSPHERIC INHOMOGENEITIES ON THE SONIC BOOM Ph.D. Thesis

Kenneth Jay Plotkin 1971 200 p

Avail: Univ. Microfilms Order No. 71-17122

The effect of atmospheric inhomogeneities on the sonic boom and other weak waves is investigated. First, the propagation of sonic booms through a quiescent, smoothly varying atmosphere is examined. Geometric acoustics (analogous to geometrical optics) is used to extend the linearized flow (acoustic) solution from near the aircraft to distances far enough away so that atmospheric variations must be taken into account. The equations of geometric acoustics are derived, and ray paths are calculated for a horizontally stratified atmosphere. This acoustic solution is then corrected by the inclusion of lowest order nonlinear wave steepening, which gives the classical N-wave signature in the far field. A simplified method for calculating signatures at the ground directly under the flight track, without the need for a computer for each case, is presented. Dissert. Abstr.

N72-23005 Purdue Univ., Lafayette, Ind.

A FEASIBILITY STUDY OF ACTIVE CONTROL TO IMPROVE THE PERFORMANCE AND VIBRATION CHARACTERISTICS OF ROTOR BLADES Ph.D. Thesis

Donald Thomas Gordon 1971 181 p

Avail: Univ. Microfilms Order No. 71-20465

Improvements in the dynamic and aerodynamic performance of helicopter rotor blades are investigated. The major portion of the research involves the development of a digital computer simulation for the rotor blade. The simulation utilizes a discrete

mass model of a rotating, cantilevered blade with generalized physical properties. This analysis is limited to coupled flap bending/torsion motion. External effects can be introduced as forces, accelerations, velocities, and displacements at almost any point on the blade. Time step integration allows analysis of transient effects, steady state motion, and instabilities. A set of trailing edge flaps along the entire length of the blade is used as a lift augmentation device. The final portion of the analysis is concerned with reducing the undesirable dynamic characteristics of the blade. Dissert. Abstr.

N72-23006 Illinois Univ., Urbana.
**RESPONSE OF FLIGHT VEHICLES TO NONSTATIONARY
 RANDOM ATMOSPHERIC TURBULENCE** Ph.D. Thesis
 Larry James Howell 1971 136 p
 Avail: Univ. Microfilms Order No. 71-21142

Retaining the assumptions generally imposed on a turbulence field, those of isotropy and of the frozen pattern of the gust velocity with respect to a moving vehicle, the statistical description of the gust field to one with a nonstationary random velocity is presented. Three different methods which may be used in the general nonstationary analysis are described. The evolutionary spectral method to compute response statistics of a rigid single-degree-of-freedom aircraft subjected to a uniformly modulated nonstationary random process is employed. In sharp contrast to the conventional treatment of the gust velocity as a stationary random process, response statistics which are time varying have been obtained. Dissert. Abstr.

N72-23007 Stanford Univ., Calif.
**OPTIMAL THREE DIMENSIONAL TURNING MANEUVERS
 FOR SUPERSONIC AIRCRAFT** Ph.D. Thesis
 John Karl Hedrick 1971 163 p
 Avail: Univ. Microfilms Order No. 71-19699

Using the energy-state approximation, thrust, bank angle, and altitude histories have been determined for three-dimensional turning maneuvers. In general, the change in heading angle and the initial and final energies are specified. The angle-of-attack is constrained to be less than the stall angle of the aircraft, and the thrust is constrained to be non-negative and less than the maximum attainable thrust, which is a function of Mach number and altitude. Numerical results are presented for a realistic supersonic aircraft. Control histories, state histories, and feedback control charts are presented for (1) constant altitude minimum time turns, (2) three-dimensional gliding turns, (3) three-dimensional minimum time turns, and (4) three-dimensional minimum fuel turns. Dissert. Abstr.

N72-23008# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
**REPORT ON THE DGLR-SYMPOSIUM ON DESIGN
 PROBLEMS OF V/STOL PROPELLER AND ROTORS**
 Dec. 1971 309 p refs Partly in GERMAN; partly in ENGLISH;
 ENGLISH summary Conf. held in Stuttgart, 6 May 1971
 (DLR-Mitt-71-18) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

Aerodynamic design aspects of V/STOL and STOL propellers and rotors are discussed. Considered are cyclic pitch control of tilt wing aircrafts, recovery rotor systems, and adaptation of VTOL propellers to static aerodynamic situations.

N72-23009# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).
**MODERN TECHNOLOGY IN THE DEVELOPMENT OF
 V/STOL PROPELLERS AND ROTORS [MODERNE
 TECHNOLOGIEN IN DER ENTWICKLUNG VON V/STOL-
 PROPELLERN UND ROTOREN]**

H. Huber and H. Weiss /in DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 7-46 refs In GERMAN
 (DGLR-71-016) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

A systematic development of flight mechanical aspects is used to obtain technological construction and design specifications for V/STOL propellers and rotors. Considered are aerodynamic parameters, expected loads, frequency and stability, and typical maneuver dynamics. Emphasis is placed on the peculiarities of cyclic pitch propellers and the application of modern fiber technology to laminar propeller construction methods.

Transl. by G.G.

N72-23010# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Munich (West Germany).
**PROBLEMS IN AERODYNAMIC LAYOUTS OF V/STOL
 PROPELLERS [PROBLEME DER AERODYNAMISCHEN
 AUSLEGUNG VON V/STOL-PROPELLERN]**
 P. Ebeling /in DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 47-83 refs In GERMAN
 (DGLR-71-017) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

Numerical optimization methods for aerodynamic V/STOL propeller design analyses are evaluated. It is shown that the application of these methods requires exact formulations of the optimization goal and of important parameters. Precise numerical prediction of propeller performance on ground is important because it affects working load differences. Transonic profile properties influence markedly VTOL propeller design for very high flight speeds. Transl. by G.G.

N72-23011# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
**MEETING PROPULSION NEEDS OF FUTURE HIGH
 PERFORMANCE V/STOL** c28
 A. Jackson /in DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 85-133

(DGLR-71-018) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

Several STOL and V/STOL aircraft systems are studied for future requirements and evolutionary propulsion design approaches with emphasis on environmental pollution and noise reduction. Advanced technology transports considered are a high speed STOL with thrust requirements intermediate between propellers and fans, and a quiet STOL. Initial noise tests on model fans confirm the acoustic benefits of low fan tip speed and low fan exhaust velocity. STOL aircraft system studies confirm that the prop-fan propulsion system offers the best solution for future STOL requirements. Transl. by G.G.

N72-23012# Boeing Co., Philadelphia, Pa. Vertol Div.
**CYCLIC PITCH CONTROL ON A V/STOL TILT-WING
 AIRCRAFT**
 H. Rosenstein and C. E. Kolesar /in DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 135-190 refs
 (DGLR-71-019) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

Results are presented of a model wind tunnel test program that was directed toward investigating the use of cyclic pitch propellers as the low speed longitudinal control system of a V/STOL tilt wing aircraft. The pitch control effectiveness of this system through transitional flight and in ground effect is discussed and the power increase associated with its use is shown. Data are presented to illustrate the small influence that cyclic pitch inputs have on longitudinal stability and lateral/directional stability. Cyclic-pitch control coupled with stabilizer control is discussed along with crosscoupling of cyclic pitch with the wing surface controls for roll/yaw control. Author

N72-23013# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

SOME SELECTED PROBLEMS OF ROTOR SUPPORTED RECOVERY SYSTEMS. PART 1: DESIGN [EINIGE AUSGEWAHLTE PROBLEME BEI ROTORGESTUETZTEN BERGESYSTEMEN. TEIL 1: ENTWURF]

H. Stoecklin and H. Zimmer /In DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 191-226 refs In GERMAN

(DGLR-71-020-Pt-1) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

The design and aerodynamic characteristics of an unmanned rotary recovery device is reported. The device functions as rudder during flight and controls gear, roll, and angle steering mechanisms. During the transition phase to rotor flight, hydraulic agitation tilts rotor blades and unfolds telescopic blade extensions so that the rudder mechanism acts as an autorotating propeller.

Transl. by G.G.

N72-23014# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

SOME SELECTED PROBLEMS OF ROTOR SUPPORTED RECOVERY SYSTEMS. PART 2: AERODYNAMICS OF ROTORS WITH AXIAL DESCENDING FLOW [EINIGE AUSGEWAHLTE PROBLEME BEI ROTORGESTUETZTEN BERGESYSTEMEN. TEIL 2: AERODYNAMIK DES AXIAL ANGESTROMTEN ABSTEIGENDEN ROTORS]

H. Zimmer /In DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 227-244 In GERMAN

(DGLR-71-020-Pt-2) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

An impulse wing-blade theory is used to calculate the aerodynamics of a rotary recovery system for flying bodies during transition from horizontal flight to gliding flight. Calculated are aerodynamic force distribution and the combined values of thrust and momentum for an axial descending rotor flow.

Transl. by G.G.

N72-23015# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

A REVIEW OF STATIC THRUST AND CYCLIC PITCH TECHNOLOGY FOR V/STOL PROPELLERS

R. J. Hirt /In DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 245-284

(DGLR-71-021) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

A brief summary of the status of technology from the standpoint of propeller performance, hover/low speed control and propeller-wing aerodynamics interaction effects is presented. Data are presented that illustrate the improvements that have been made in static efficiency. The penalties associated with the use of cyclic pitch propellers are also presented. Control powers are briefly discussed because of the relationship of longitudinal control and the cyclic pitch propeller.

Author

N72-23016# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Munich (West Germany).

METHODS FOR DEVELOPING THE ADAPTABILITY OF VTOL PROPELLERS [METHODEN ZUR ENTWICKLUNG DER ANPASSUNGSFAEHIGKEIT VON VTOL-PROPELLERN]

R. Huber and J. Wimbauer /In DGLR Rept. on the DGLR-Symp. on Design Probl. of V/STOL Propellers and Rotors Dec. 1971 p 287-306 refs In GERMAN

(DGLR-71-023) Avail: NTIS HC \$17.50; ZLDI Munich: 64.90 DM

The cost effectiveness is discussed of a VTOL propeller with blow down edges that increases hovering ability and compensates for output loss caused by noise reduction through decreased propeller Mach number.

Transl. by G.G.

N72-23017*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

TERMINAL-AREA GUIDANCE ALGORITHMS FOR AUTOMATED AIR-TRAFFIC CONTROL

Heinz Erzberger and Homer Q. Lee Washington Apr. 1972 83 p refs

(NASA-TN-D-6773; A-3741) Avail: NTIS HC \$3.00 CSCL 17G

Terminal-area guidance problems are solved in the form of computer-oriented algorithms. A flyable, three-dimensional trajectory is constructed that begins at the current aircraft position, heading, speed, and altitude, and that terminates at a prescribed position, heading, speed, altitude, and time. The terminal position is a waypoint and the terminal time is the assigned landing slot. The algorithms developed are applicable to all possible combinations of initial and final conditions, and thus can be used in a closed-loop feedback law.

Author

N72-23018# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

FOUR INTRODUCTORY LECTURES ON AERODYNAMIC NOISE THEORY

H. V. Fuchs and A. Michalke 11 Oct. 1971 113 p refs Presented at Short Course on Aircraft Noise, Tullahoma, Tenn., 15-19 Mar. 1971

(DLR-Mitt-71-20) Avail: NTIS HC \$7.75; DFVLR Porz-Wahn: 27.90 DM

An introduction is presented to the theory of aerodynamic sound generation. A general integral solution to the inhomogeneous wave equation is discussed including the effect of boundaries. Lighthill's acoustic analogy is described in terms of equivalent simple sources. Certain approximations are given for the far-field sound intensity. Dimensional analysis is performed neglecting the effect of retarded times. Jet noise is treated on the assumption of a specific structure of the turbulence convected by the flow. Some approaches alternative to Lighthill's theory are indicated. Spectral methods in jet noise theory are treated. Individual frequency components of the sound intensity are derived by means of a Fourier transform with respect to time. Their directivities are discussed on the basis of two differing methods.

N72-23019# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

AERODYNAMIC NOISE THEORY 1 (GENERAL ASPECTS)

H. V. Fuchs /In its Four Introductory Lectures on Aerodyn. Noise Theory 11 Oct. 1971 p 7-31 refs

Avail: NTIS HC \$7.75; DFVLR Porz Wahn: 27.90 DM

A numerical analysis of flow noise theory is presented. The derivation of the governing equations is described in general terms while specifications feasible for special flow configurations and boundaries are treated less comprehensively. Consideration is given to the source element as an equivalent monopole emitter, an equivalent dipole emitter, and an equivalent quadrupole emitter. Mathematical models are included to support the theoretical concepts.

Author

N72-23020# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

AERODYNAMIC NOISE THEORY 2 (APPROXIMATE PROCEDURES)

H. V. Fuchs *In its Four Introductory Lectures on Aerodyn. Noise Theory* 11 Oct. 1971 p 32-50 refs

Avail: NTIS HC \$7.75; DFVRL Porz-Wahn: 27.90 DM

A theoretical treatment of the properties of radiated far-field sound is presented. Subjects discussed are: (1) simplification of the radiated far-field, (2) near and far-field of monopole-type sources, dipole-type sources, and quadrupole-type sources, (3) intensity of radiated sound, (4) idealized model of turbulence structure, and (5) dimensional analysis of aerodynamic sound production. Mathematical models are included to support the theoretical concepts. Author

N72-23021# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

AERODYNAMIC NOISE THEORY 3 (JET NOISE)

H. V. Fuchs *In its Four Introductory Lectures on Aerodyn. Noise Theory* 11 Oct. 1971 p 51-90 refs

Avail: NTIS HC \$7.75; DFVLR Porz-Wahn: 27.90 DM

The characteristics of free turbulence as a source of aerodynamic noise are discussed. Application to a topical problem, that of the noise from jets, is described. Modifications to flow theory, which are required for flows where turbulence is convected at high speeds, are examined. Emphasis is placed on the acoustic power radiated by a jet, its frequency, and directivity. Author

N72-23022# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin (West Germany). Inst. fuer Turbulenzforschung.

SPECTRAL METHODS IN JET NOISE THEORY

A. Michalke *In its Four Introductory Lectures on Aerodyn. Noise Theory* 11 Oct. 1971 p 91-114 refs

Avail: NTIS HC \$7.75; DFVRL Porz-Wahn: 27.90 DM

Spectral methods in jet noise theory with emphasis on the solution of numerical relationships are presented. The subjects discussed are (1) a solution of flow equations for frequency components, (2) calculation of the directivity of sound intensity, (3) Fourier analysis of the source term and integral solution, (4) the sound pressure components far from the source region, and (5) sound generation by wave-type jet turbulence. Author

N72-23023# Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).

EXTREME VALUE ANALYSIS AND ITS APPLICATION TO CG VERTICAL ACCELERATIONS MEASURED ON TRANSPORT AIRPLANES OF TYPE C-130

Otto Buxbaum Paris AGARD Mar. 1971 25 p refs (AGARD-579) Avail: NTIS HC \$3.25

The interpretation of cumulative frequency distributions of measured flight loads can be increased significantly by an additional extreme value analysis. This method not only leads to a higher reliability in fatigue design but may be used also for a prediction of extreme loading conditions and for a description of the effect of airplane and flight parameters on loads, as is demonstrated for c.g. vertical accelerations and gust velocities measured on airplanes of type C-130. Author

N72-23024*# Scientific Translation Service, Santa Barbara, Calif.

HELICOPTER AERODYNAMICS

D. I. Bazov Washington NASA May 1972 292 p refs Transl. into ENGLISH of the book "Aerodinamika Vertoletov" Moscow, Transport Press, 1969 p 1-190 (Contract NASw-2035)

(NASA-TT-F-676) Avail: NTIS HC \$3.00 CSCL 01B

Principles of helicopter flight under various conditions are reviewed, giving special attention to the operation of the main rotor. A brief history of helicopter development is presented, together with a summary of the main components of a helicopter and a classification of the various types of helicopters. The characteristics of the main rotor and its operation during autorotation and during axial and oblique flow are considered. Also considered are vertical and horizontal flight, altitude gain and descent, takeoff and landing, equilibrium, stability, and controllability, taking into account the aerodynamic forces acting on the helicopter during the various maneuvers. Author

N72-23025*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

MEASURED NOISE OF MODEL FAN-UNDER-WING AND FAN-ON-FLAP JET FLAP CONFIGURATIONS

John F. Groeneweg and Gene L. Minner Washington May 1972 56 p refs

(NASA-TN-D-6781; E-6739) Avail: NTIS HC \$3.00 CSCL 01B

Noise measurements were made on two jet flap systems proposed for STOL aircraft. In one case a 14.0-cm- (5.5-in.-) diameter fan was mounted under the wing such that the exhaust impinged on downwardly deflected flap segments. In the other case, the fan was located on the upper surface of the flap such that fan and flap moved as a unit, with no exhaust impingement. Results for takeoff and approach fan speeds and flap deflections were used to estimate STOL airplane perceived noise levels. Internally generated noise directivity corresponded with fan axis orientation for the fan-on-flap, but no consistent redirection of internal noise was observed with changes in flap angle for the fan-under-wing. With the fan-on-flap arrangement, the wing shielded some fan inlet noise from the ground. Since no impingement of the exhaust on solid surfaces occurred, the external noise was jet noise alone. In contrast, for the fan-under-wing, the jet/flap interaction noise dominated the external noise except at angles near the jet axis even with no flap deflection. If internal noise is reduced by fan design and acoustic treatment, the jet/flap interaction noise will dominate. Author

N72-23026# Boeing Scientific Research Labs., Seattle, Wash. Aerospace Group.

A THEORETICAL MODEL FOR THE HEATING OF AN AIRPLANE WING FROM A LIGHTNING DISCHARGE

F. Edward Ehlers and Donald F. Winter Oct. 1971 27 p refs (D180-14190-1) Avail: NTIS HC \$3.50

It is currently believed that most structural damage from lightning is caused by continuous-prolonged relatively low-current (50 to 2000 amperes) discharges between major strokes. The temperature response of a metal plate to a steady electric current input on its exterior surface is described analytically. The validity of the analysis is limited to intervals of time prior to significant energy loss by vaporization of the metal. Experimental studies indicate that the current density normal to a plate anode from an argon arc is approximated closely by a Gaussian distribution or by a combination of Gaussian distributions. The solution of the heat equation was found for a Gaussian distribution of normal heat flux on one surface of a plate with the other surface insulated. Internal Joule heating is neglected. The analysis was applied to finding the maximum temperature on the insulated side of the plate on the arc axis for various total currents and pulse times. Author

N72-23027*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

FLIGHT-DETERMINED DERIVATIVES AND DYNAMIC CHARACTERISTICS OF THE CV-990 AIRPLANE

Glenn B. Gilyard Washington May 1972 66 p refs

(NASA-TN-D-6777; H-693) Avail: NTIS HC \$3.00 CSCL 01C

Flight-determined longitudinal and lateral-directional stability

and control derivatives are presented for the CV-990 airplane for various combinations of Mach number, altitude, and flap setting throughout the flight envelope up to a Mach number of 0.87. Also presented are the dynamic characteristics of the aircraft calculated from the flight-obtained derivatives and the measured phugoid characteristics. The derivative characteristics were obtained from flight records of longitudinal and lateral-directional transient oscillation maneuvers by using a modified Newton-Raphson digital derivative determination technique. Generally the derivatives exhibited consistent variation with lift coefficient in the low-speed data and with Mach number and altitude in the high-speed data. Many also varied with flap deflection, notably spoiler effectiveness and directional stability. Author

**N72-23028# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE PROBLEM OF PROGRAMMED CONTROL OF
FLYING VEHICLE MOTION**

S. M. Cherniavskii [1972] 8 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavdenii, Aviat. Tekhn. (Kazan), no. 4, 1971 p 19-27

Avail: NTIS HC \$3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The problem of programmed control of flight vehicle motion is discussed. The flight dynamics are investigated in a linear formulation because of the complexity of the relationships. Three specific problems are discussed and mathematical models are presented to support the theoretical concepts. Author

**N72-23029# Northrop Corp., Palos Verdes Estates, Calif.
Electronics Div.**

**CONCEPT FORMULATION STUDY FOR AUTOMATIC
INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS
(AIDAPS), VOLUME 1 Interim Report**

Jul. 1971 77 p refs

(Contract DAAJ01-71-C-0503; DA Proj. 1F1-64204-DC-32)

(AD-736754; NORT-71-229-Vol-1;

USAAVSCOM-TR-72-2-Vol-1; IR-2-Vol-1) Avail: NTIS CSDL 01/3

The report consists of the plan of analysis which describes the models and procedures to be used to perform the trade-offs during Phase C of the Concept Formulation Study for Automatic Inspection, Diagnostic and Prognostic Systems (AIDAPS) for Army aircraft. Section 2.0 describes the AIDAPS/aircraft maintenance analysis and effectiveness model. Section 3.0 presents the AIDAPS system procurement cost model. Section 4.0 discusses the AIDAPS system cost benefit model which compares the life cycle of AIDAPS equipped versus non-AIDAPS equipped aircraft. Section 5.0 references an aircraft maintenance operation model which shall be used in conjunction with the models described in Section 2.0. Section 6.0 presents a summary of the manner in which the optimum system will be selected. Author (GRA)

**N72-23030# Northrop Corp., Palos Verdes Estates, Calif.
Electronics Div.**

**CONCEPT FORMULATION STUDY FOR AUTOMATIC
INSPECTION, DIAGNOSTIC AND PROGNOSTIC SYSTEMS
(AIDAPS), VOLUME 2 Interim Report**

Jul. 1971 282 p refs

(Contract DAAJ01-71-C-0503; DA Proj. 1F1-64204-DC-32)

(AD-736755; NORT-71-209-2-Vol-2;

USAAVSCOM-TR-72-2-Vol-2; IR-2-Vol-2) Avail: NTIS CSDL 01/3

The report represents the second interim report prepared as part of the concept formulation study for Automatic Inspection, Diagnostic and Prognostic Systems (AIDAPS) for Army aircraft. The principal objective of this Phase B effort is the identification of AIDAPS technical approaches and concepts that fall within the engineering feasibility limitations established in Phase A. Author (GRA)

**N72-23031# Air Force Systems Command, Wright-Patterson
AFB, Ohio. Foreign Technology Div.**

PRACTICAL AERODYNAMICS OF THE YAK-40 AIRPLANE

L. E. Bogoslavskii 7 Dec. 1971 250 p refs Transl. into ENGLISH of the publ. "Prakticheskiye Aerodinamika Samoleta Yak-40" USSR, 1970 p 1-176

(Contract F33657-71-D-0057)

(AD-736902; FTD-HC-23-729-71) Avail: NTIS CSDL 01/3

The book presents the geometric and flight characteristics of the Yak-40 passenger airplane, discusses questions of piloting technique, and gives concrete recommendations for performing flight under various conditions. Information is presented on the airplane center-of-gravity, equilibrium, stability and controllability, flight under unusual conditions, piloting the airplane in case of engine failure and in turbulent air. Some basic theory-of-flight information is also covered in order to facilitate the study of practical aerodynamics and flight operations. Author (GRA)

**N72-23032# Frost Engineering Development Corp., Englewood,
Colo.**

**DEVELOPMENT OF IMPROVED AIRCRAFT SEAT
CUSHIONS AND PARACHUTE SUPPORT SPACERS Final
Report, Jul. 1967 - Jan. 1971**

Richard H. Frost, Ernest L. Stech, and George K. Russell Aug. 1971 119 p refs

(Contract F33657-67-C-1520)

(AD-736873; Rept-341-9; ASD-TR-71-80) Avail: NTIS CSDL 01/3

The purpose of this program was to improve the efficiency and safety of air crews by development of seat cushions and parachute support spacers which would give superior comfort in long-duration seating yet minimize the incidence of spinal injury in ejections and crash landings. Exhaustive testing of existing cushions and spacers was followed by establishment of criteria for optimum construction. Investigation and development of new materials potentially capable of fulfilling these requirements was made. Author (GRA)

**N72-23033# Stanford Univ., Calif. Dept. of Aeronautics and
Astronautics.**

**CONSTANT ALTITUDE MINIMUM TIME TURNS TO A
LINE AND TO A POINT FOR A SUPERSONIC AIRCRAFT
WITH A CONSTRAINT ON MAXIMUM VELOCITY Interim
Report**

Arthur E. Bryson, Jr. and Michael G. Parsons Nov. 1971 69 p refs

(Contract N00014-67-A-0112-0063; NR Proj. 213-085)

(AD-736964; SUDAAR-437) Avail: NTIS CSDL 01/3

Optimal control theory is used to determine the thrust and bank angle programs for minimum time turns of a supersonic aircraft to a specified point or line when constant altitude is maintained. A stall constraint, a maximum velocity placard limit, a maximum normal load constraint, and maximum and minimum thrust limits are imposed. Numerical results are presented for a typical supersonic aircraft at 25,000 feet altitude when the turns are such that an intermediate thrust arc at the maximum velocity placard limit is reached during the flight. These turns are characterized by a period of straight flight at maximum velocity. Author (GRA)

**N72-23034# Army Test and Evaluation Command, Aberdeen
Proving Ground, Md.**

AIRCRAFT ROCKET SUBSYSTEMS Final Report

15 Jan. 1972 26 p refs

(AD-737177; MTP-7-2-009) Avail: NTIS CSDL 01/3

The report describes a method for the evaluation of air to ground rocket subsystem performance characteristics. It provides procedures for test preparation, physical characteristics, safety evaluation, high temperature (-145 F), low temperature (-50 F),

sand, dust, humidity, salt spray, fungus, rain, freezing rain, vibration, static loading, firing tests, durability, accuracy, and dispersion. GRA

N72-23035# Naval Air Test Center, Patuxent River, Md.
FLIGHT INVESTIGATION OF THE OPTIMUM ENERGY FLIGHT PATH OF AN F-8D AIRPLANE Final Report
 F. T. Bryan 4 Feb. 1972 22 p refs
 (AD-737377; NATC-FT-9R-72) Avail: NTIS CSCL 01/2

A thirteen flight program was conducted to determine a minimum time optimum energy flight path schedule for a test F-8D airplane and to provide data for a comparison of the time required to achieve equivalent supersonic energy levels when utilizing this schedule and two other predetermined flight path schedules. Author (GRA)

N72-23036# Naval Air Systems Command, Washington, D.C. Professional Development Center.

A NEW APPROACH TO THE CALCULATION OF THE EFFECT OF THE GROUND ON THE PERFORMANCE OF ROTARY WING AIRCRAFT

Eugene M. Newman 1 Nov. 1971 29 p refs
 (AD-736925; SP-71-02) Avail: NTIS CSCL 01/3

An investigation of the helicopter ground effect prediction methodology was made and evaluated. Prediction of IGE performance for single rotor helicopters of a conventional type at z/D 's greater than .4 can be attained with a reasonable degree of accuracy through the use of empirical curves which consider rotor geometry only. Improved accuracy can be attained by use of the new method developed for this investigation which gives results that reflect changes in fuselage shape as well as rotor geometry. While insufficient data was available, the new method appears to provide a means of predicting ground effect for compound type vehicle that entail significant configuration changes. Author (GRA)

N72-23037# Air Force Academy, Colo.
STRUCTURAL FLIGHT TEST OF AN AC-130A GUNSHIP EMPENNAGE

John J. Russell Oct. 1971 55 p refs
 (AD-737350; USAFA-RR-71-9) Avail: NTIS CSCL 01/3

An AC-130A aircraft empennage was instrumented with electrical-resistance strain gages and flight test data was obtained for anti-aircraft evasive maneuvers, 20mm General Electric Vulcan cannon firings, and 40mm Bofors gun firings. Complete descriptions of the test instrumentation, test conditions, strain gage locations, and results are contained in the report. Strain gages were located in the aircraft empennage area based on minimum margins of safety as found in the original Lockheed stress analysis. Results show that those stresses caused by gun firing, either 20mm or 40mm, are quite small and that the sum of the stresses due to the left hand orbit maneuver and the gun firing is well below design limits. Stresses produced by anti-aircraft evasive maneuvers were also found to be well below design limits. Author (GRA)

N72-23039# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.

FLIGHT EVALUATION OF ENGINE RESPONSE, FLIGHT PATH STABILITY, TAIL LIFT, AND DIRECT LIFT CONTROL Final Report, Jul. 1969 - Oct. 1971

George E. Miller and Robert L. Traskos Aug. 1971 113 p refs
 (Contract N00019-70-C-0156)
 (AD-736968; Rept-888) Avail: NTIS CSCL 01/3

The results of an aircraft flying qualities research program sponsored by the Naval Air Systems Command are presented. For a simulated carrier approach task, numerical pilot ratings and

specific comments were obtained from Navy test pilots. The parameters evaluated were the engine response, flight path stability, tail lift, and direct lift control. Data are presented in the form of pilot opinion maps of the parameters, tabulated configuration ratings, and pilot comments. Author (GRA)

N72-23040# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

BRIEFS OF AIRCRAFT ACCIDENTS INVOLVING AMATEUR/HOME BUILT AIRCRAFT, US GENERAL AVIATION, 1969

1971 45 p
 (PB-206040; NTSB-AMM-71-13) Avail: NTIS HC \$3.00 CSCL 01B

The publication contains statistical, cause/factor and injury tables, accident rates and the briefs of accidents involving amateur/home built aircraft 1969. Author (GRA)

N72-23041# Honeywell, Inc., St. Paul, Minn. Systems and Research Center.

IFR MANUAL FORMATION FLIGHT: DISPLAY EVALUATION AND INVESTIGATION OF SKILL ACQUISITION AND SYSTEM FAILURES Final Technical Report, Jul. 1970 - Jun. 1971

P. A. Anderson and S. R. Hollingsworth Jan. 1972 148 p refs
 (Contract N00014-66-C-0362; NR Proj. 213-054)
 (AD-737313; JANAIR-710602; Honeywell-12543-FR7) Avail: NTIS CSCL 01/4

Man-in-the loop simulations were conducted to evaluate pilot/system performance for the UH-1 helicopter under various experimental conditions. The empirical results indicated that there were no major performance differences between the IHAS and IEVD display formats although the IEVD tended to yield lower position errors and control stick rates; experienced and inexperienced pilots learned the formation-flight task in a relatively short period of time when display augmentation (quickening) was provided; approximately the same level of control precision was acquired by both groups of pilots; position control performance degraded drastically when augmentation was downgraded or removed from the display; the pilots could successfully leave formation with or without command information, but the maneuver was more precise with the commands; and acceptable formation-flight performance was obtained with an electromechanical flight director display system although the simulated collision warning system was not capable of avoiding all collisions. Author (GRA)

N72-23042# Douglas Aircraft Co., Inc., Long Beach, Calif.
THEORETICAL STUDIES ON THE AERODYNAMICS OF SLAT AIRFOIL COMBINATIONS Final Report

Robert H. Liebeck 28 May 1971 67 p refs
 (Contract F44620-70-C-0108; AF Proj. 9781)
 (AD-737126; MDC-J5195; AFOSR-72-0369TR) Avail: NTIS CSCL 01/3

The report describes the results of a theoretical study on the analysis and design of leading edge slat plus main airfoil combinations. Two basic methods were used: representation of the slat by a point vortex, and representation of the slat by a set of thin airfoil theory singularity distributions. Computer programs were prepared. For method 1 the main airfoil was chosen from an infinite set of airfoils whose mapping functions to the unit circle are analytically defined. A leading edge slat providing a specified velocity modulation on the nose region of a main airfoil was studied by method 2. GRA

N72-23043# Instrument Pilot Instructor School, Randolph AFB, Tex.

EVALUATION OF MODIFICATION PROPOSAL TO INCREASE ADI AND HSI LIGHTING ON T-38 AIRCRAFT

Max L Odle Dec. 1971 47 p refs
(AD-737121; IPIS-71-4) Avail: NTIS CSCL 13/1

The Test and Evaluation Branch of the United States Air Force Instrument Pilot Instructor School (IPIS) conducted an evaluation of a modified T-38 Attitude Director Indicator/Horizontal Situation Indicator (ADI/HSI) lighting system proposed by the Deputy for Materiel, Moody AFB, Georgia. The modification specified removal of a 0.25 ohm resistor from the ADI/HSI lighting system. For evaluation purposes, five T-38 front and back seat ADI/HSI lighting systems were modified. The modified aircraft were then scheduled with unmodified T-38s for night flying. Subject pilots were not made aware that modifications had been completed on any aircraft to avoid biased questionnaires. Eighty-five subjective questionnaires were completed by a diversified group of student instructor pilots and instructor pilots. Ten pilots of this group flew the modified aircraft. Author (GRA)

N72-23044# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT, ROCKY MOUNTAIN AIRWAYS, INCORPORATED AERO COMMANDER 680V, N6359U, ASPEN, COLORADO, 22 JANUARY 1970

29 Dec. 1971 33 p refs
(PB-206562; NTSB-AAR-72-01) Avail: NTIS HC \$3.00 CSCL 01B

Aero Commander 680V, N6359U, crashed at approximately 0806 mountain standard time, January 22, 1970, near Aspen, Colorado. The aircraft struck obstructing terrain after the pilot discontinued an approach to land because of an ice accumulation on the windshield of the aircraft. The National Transportation Safety Board determines that the probable cause of this accident was the pilot's use of other than the recommended procedures for a go-around following the discontinuance of a landing approach. The landing approach was discontinued, and a go-around attempted because the aircraft was too high to attempt a straight-in approach. The ice accumulation on the windshield obscured the obstructing terrain. Author (GRA)

N72-23045# Advisory Group for Aerospace Research and Development, Paris (France).

AGARD ANNUAL MEETING

1971 79 p Conf. held at Nord-Torpa, Norway, 8 Sep. 1971
(AD-737396) Avail: NTIS CSCL 01/2

Each autumn, AGARD holds its annual meeting in one of the NATO member nations to develop general guide lines for future activities. This gives the host nation the opportunity to present its research and development program from the standpoint of the government, industry and the universities. The 1971 AGARD annual meeting was hosted by the Norwegian Government at the Spatind Hotel, Nord-Torpa, Norway, 8 September 1971. Author (GRA)

N72-23046# Explosive Technology, Inc., Fairfield, Calif.

AN EMERGENCY LIFE-SAVING INSTANT EXIT SYSTEM FOR CARGO, CARGO-TRANSPORT AND PASSENGER AIRCRAFT, VOLUME 1 Technical Report, May 1970 - Jul. 1971

Dallas E. Nicholson and Frank B. Burkdoll Wright-Patterson AFB, Ohio AFSC Aeron. Systems Div. Jun. 1971 92 p refs
(Contract F33657-70-C-1138)
(AD-736056; ASD-TR-71-41-Vol-1) Avail: NTIS CSCL 06/7

The results of a design study and ground testing of an Emergency Life-Saving Instant Exit (ELSIE) System for military and commercial cargo, cargo-transport and passenger aircraft are described. The ELSIE System opens emergency exits in aircraft almost instantaneously and can be designed to open all exits at one time or on a selective basis. The design evolved from Explosive Technology's STEN (Stored Energy) Passenger Egress System originally developed in 1967 and continuously demonstrated since then. The contracted work represented the

design and testing of an ELSIE System specifically for demonstration on a C-131B test-bed aircraft. This document is Volume I of a two-volume report. Author (GRA)

N72-23047# Naval Postgraduate School, Monterey, Calif.
INTERFACE OF MATERIALS AND STRUCTURES ON AIRFRAMES. PART 3: DESIGN PROBLEMS IN AIRCRAFT STRUCTURES INCLUDING PROCEEDINGS OF MONTEREY SYMPOSIUM Final Report

Ulrich Haupt Oct. 1971 232 p refs Conf. held at Monterey, Calif., 15-16 Jul. 1971
(AD-736207; NPS-57HP71111A-Pt-3) Avail: NTIS CSCL 01/3

The proceedings of the Monterey Symposium on Design Problems in Aircraft Structures provide a basic survey of design problems from the engineers' viewpoint. Further analysis of the present situation draws attention to some essential aspects which are not yet generally recognized. This leads to the conclusion that recent design problems cannot be solved on a technological level alone. An organizational effort is needed to disseminate available information. Beyond this, the complexity of interactions must be understood more thoroughly and this requires an educational effort on a broad basis. A practical and systematic approach toward the solution of these problems is developed. Author (GRA)

N72-23126# Joint Publications Research Service, Washington, D.C.

DUAL ANTENNA METHOD OF SUPPRESSING REFLECTIONS FROM UNDERLYING SURFACE

V. I. Kustov and M. B. Tenin May 1972 16 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Inst., Teoriya Tekh. Radiolokatsii (Moscow), no. 178, 1968 p 147-161
(JPRS-55908) Avail: NTIS HC \$3.00

An attempt is made to solve the problems associated with high signal fluctuations in moving target indicators by the dual antenna method. The method employs two antennas, located on the lower part of the aircraft, which are connected alternately to a radar transmitter. The first antenna emits a sounding pulse from a certain point in space and receives the reflected signal. The signals are amplified, detected, and delayed for a time by a first receiver. The second antenna carries out the same function from the same point as the first antenna using a second receiver. The signals from the second antenna are then subtracted from the delayed signals of the first antenna thus compensating reflections from the underlying surface of the aircraft. E.H.W.

N72-23144# Air Force Human Resources Lab., Williams AFB, Ariz. Flying Training Div.

EVALUATION OF AN AIRBORNE AUDIO-VIDEO RECORDING SYSTEM FOR AIRCRAFT EQUIPPED WITH HEAD-UP DISPLAY

Joe A. Fitzgerald May 1971 19 p refs
(AF Proj. 1123)

(AD-736818; AFHRL-TR-71-20) Avail: NTIS CSCL 05/9

The objective of the project was to provide a low-cost, reliable audio-video recording system (AVRS) for aircraft equipped with Head-Up Display (HUD) that would be capable of recording both the external real world cues through the aircraft's forward windscreen as well as the symbology of the HUD projected on the aircraft's combining glass. The ultimate objective is a research program to assess audio-video recording in HUD-equipped aircraft as both technique for improvement of training and as a tool for pilot proficiency assessment. Two A-7D aircraft were fitted with an AVRS constructed from low-cost, commercial equipment with a good record of reliability. The equipment was modified to make it compatible with the aircraft and its flight environment. The system proved capable of recording the symbology on the HUD, as well as resolving ground targets at normal altitudes and slant ranges encountered in the training environment. Author (GRA)

N72-23164# Naval Research Lab., Washington, D.C.
ANOTHER ASSOCIATIVE PROCESSOR Interim Report
 John E. Shore and Terry L. Collins 30 Dec. 1971 23 p refs
 (NRL Proj. R06-41)
 (AD-737188; NRL-7348) Avail: NTIS CSCL 09/2

The logical design of an associative processor (AP), which has evolved from the design previously reported in NRL Report 6961, has now been oriented toward the requirements of the Advanced Avionic Digital Computer (AADC) under development by the Naval Air Systems Command. The AP is a bytevariable processor with multifield search, arithmetic, and logical capability. Data flow within the AP is a vertical trickle. Data for each word is fed in from the word above and fed out to the word below. The output may be the same as the input (functionally equivalent to broadcast), may be the contents of the word itself, or may be some function of the input and the word contents. A CMOS hardware implementation of the AP design is being tested, and preliminary results indicate that some hardware revisions will be necessary. Questions of AP control have been considered, and the details will be worked out through use of a software simulation. Author (GRA)

N72-23169# Stanford Research Inst., Menlo Park, Calif.
CELLULAR LOGIC-IN-MEMORY ARRAYS, PART 2 Final Report
 William H. Kautz and Marshall C. Pease, III Nov. 1971 87 p refs
 (Contract N00014-70-C-0404; SRI Proj. 5509)
 (AD-736710) Avail: NTIS CSCL 09/2

The work reported here has developed a design for an Associative Processor (AP) and its associated equipment for use in the Advanced Avionics Digital Computer (AADC) for the Naval Air Systems Command. The design, although not fully optimized, has been carried to a point that will permit a realistic evaluation of attainable cost and performance in any given technology. The design has been developed in the specific context of the Kalman filter algorithm for optimal prediction and tracking. Its applicability to a variety of other numerical processes is also demonstrated. Author (GRA)

N72-23195# National Aeronautics and Space Administration.
 Lewis Research Center, Cleveland, Ohio.
PILOT/VEHICLE CONTROL OPTIMIZATION USING AVERAGED OPERATIONAL MODE AND SUBSYSTEM RELATIVE PERFORMANCE INDEX SENSITIVITIES
 Gary G. Leininger (Toledo Univ.), Bruce Lehtinen, and John P. Riehl 1972 24 p refs Presented at 8th Ann. NASA - Univ. Conf. on Manual Control, Ann Arbor, Mich., 17-19 May 1972
 (NASA-TM-X-68041; E-6879) Avail: NTIS HC \$3.25 CSCL 09C

A method is presented for designing optimal feedback controllers for systems having subsystem sensitivity constraints. Such constraints reflect the presence of subsystem performance indices which are in conflict with the performance index of the overall system. The key to the approach is the use of relative performance index sensitivity (a measure of the deviation of a performance index from its optimum value). The weighted sum of subsystem and/or operational mode relative performance index sensitivities is defined as an overall performance index. A method is developed to handle linear systems with quadratic performance indices and either full or partial state feedback. The usefulness of this method is demonstrated by applying it to the design of a stability augmentation system (SAS) for a VTOL aircraft. A desirable VTOL SAS design is one that produces good VTOL transient response both with and without active pilot control. The system designed using this method is shown to effect a satisfactory compromise solution to this problem. Author

N72-23221# Rome Univ. (Italy). School for Aerospace Engineering.
PRESENT AND FUTURE DEVELOPMENTS IN GAS DYNAMIC EXPERIMENTATION [PRESENTI E FUTURI SVILUPPI PER LA SPERIMENTAZIONE GASDINAMICA]

Carlo Buongiorno Dec. 1970 19 p refs In ITALIAN *Its ATTI del Centro Ric. Aerospaziali* No. 36
 Avail: NTIS HC \$3.00

Trends in gas dynamics experimentation in connection with the development of supersonic aircraft, space transportation systems, and the problems of planetary entry are reviewed. The main features are the development of wind tunnel facilities at very high Reynolds numbers, and the simulation of both stagnation enthalpies of from 500 to 1000 M joule/kg of planetary atmospheres. The development of supersonic combustion ramjets flying at Mach numbers of from 10 to 12 is also considered. Author (ESRO)

N72-23222# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNAS WHIDBEY ISLAND AND USNOF COUPEVILLE, WASHINGTON

David J. Lambiotte and Leonard J. Woloszynski Nov. 1971 112 p ref
 (NCEL Proj. 53-125)
 (AD-735860; NCEL-TN-1201) Avail: NTIS CSCL 01/5

The results of condition surveys of the airfield pavements at the U. S. Naval Air Station, Whidbey Island and U. S. Naval Outlying Field, Coupeville are presented. The surveys established statistically-based condition numbers (weighted defect densities) which were direct indicators of the conditions of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts at NAS Whidbey Island included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft, traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N72-23226# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USMCAS KANEOHE, HAWAII

H. Tomita and J. A. Garcia Nov. 1971 73 p refs
 (NCEL Proj. 53-125)

(AD-735861; NCEL-TN-1202) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the U. S. Marine Corps Air Station, Kaneohe, Hawaii, are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of the data on current aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N72-23227# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIRFIELD PAVEMENT CONDITION SURVEY, USNAS ALAMEDA, CALIFORNIA

H. Tomita and L. J. Woloszynski Nov. 1971 94 p ref
 (NCEL Proj. 53-125)

(AD-735863; NCEL-TN-1204) Avail: NTIS CSCL 01/5

The results of a condition survey of the airfield pavements at the USNAS Alameda, California are presented. The survey established statistically-based condition numbers (weighted defect densities) which were direct indicators of the condition of the individual asphaltic concrete and portland cement concrete pavement facilities. Additional evaluation efforts included photographic coverage of defect types, preparation of the construction history of the station, compilation of data on current aircraft traffic and aircraft types using the station, performance of runway skid resistance tests, and a study of the requirements for future pavement evaluation efforts. Author (GRA)

N72-23229# Princeton Univ., N.J. Dept. of Civil and Geological Engineering.

A FIRST APPROXIMATION SATELLITE TERMINAL SYSTEM EVALUATION MODEL: PROGRAM USER'S INSTRUCTION MANUAL

Jack E. Snell Aug. 1971 96 p refs

(Contract DOT-W171-3579-1)

(AD-737334; FAA-AV71-4) Avail: NTIS CSCL 01/5

A program user's manual to be used for computer programming of the First Approximation Satellite Terminal System Evaluation Model described in Federal Aviation Administration Report FAA-AV-71-1. The latter is designed to analyze the cost effectiveness of off-airport or satellite terminals as a means of relieving groundside congestion in major hub cities.

Author (GRA)

N72-23257# Sandia Labs., Albuquerque, N.Mex. Atmospheric Fluid Dynamics Div.

AIRBLAST WAVES FROM CONTAINED UNDERGROUND EXPLOSIONS

Jack W. Reed Dec. 1971 23 p refs Sponsored by AEC

(SC-RR-710612) Avail: NTIS

Relatively weak shock waves are induced into the atmosphere by ground surface motion above contained underground nuclear explosives (NE) bursts. Aircraft participating in experiments occasionally have received significant jolts from these waves. Methods were derived, combining theory and empiricism, for predicting these piston waves and establishing safe operating limits for air operations. Vertical cross-sections were prepared showing the range of 0.1 psi (7 mb) and 0.2 (14 mb) overpressures for 1 kt NE bursts in hard rock at various burst depths. Distance scaling rules for other yields are derived and shown.

Author (NSA)

N72-23263# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.

AN ANALYTICAL STUDY OF THE SCRAMJET EXHAUST EXPANSION SYSTEM, PART 4 Final Technical Report, 1 Sep. 1970 - 31 Aug. 1971

Joe D. Hoffman and H. Doyle Thompson Wright-Patterson AFB, Ohio AFAPL Nov. 1971 48 p refs

(Contract F33615-67-C-1068; AF Proj. 3012)

(AD-736465; AFAPL-TR-67-142-Pt-4) Avail: NTIS CSCL 20/4

The research was designed to study the losses in a scramjet exhaust expansion nozzle and to develop methods of designing the exhaust expansion system to maximize the thrust or minimize the sum of the losses. The overall program includes a literature survey and the development of computer programs for the following purposes: to design optimized axisymmetric and plug nozzles accounting for boundary layer effects, to design axisymmetric nozzles with nonequilibrium chemical reactions, to design axisymmetric nozzles for gas-particle flows, to analyze isentropic flow in a three-dimensional nozzle, to analyze nonequilibrium, chemically reacting flow in three-dimensional nozzles, and to design optimized three-dimensional nozzles. The design problems are formulated using variational calculus to obtain the maximum thrust; the problem constraints are imposed by using Lagrange multipliers. The results of the fifth and final year's effort are summarized.

Author (GRA)

N72-23400# National Aviation Facilities Experimental Center, Atlantic City, N.J.

A STUDY OF ATMOSPHERIC IONIZATION: MEASUREMENTS OF THE ION CONDITIONS IN AN ATC LABORATORY AND A REVIEW OF THE LITERATURE OF ION EFFECTS ON PERFORMANCE Final Report

Bruce L. Rosenberg May 1972 69 p refs

(Proj. 198-001-01X; Proj. 215-201-01X)

(FAA-NA-72-19) Avail: NTIS HC \$5.50

Irritating sensations affecting the face, nose, and eyes when working at ATC radar positions were reported. The possibility was considered that an atmospheric ion imbalance, due to the high voltages present on the equipment could be the cause of the observed sensations. Ion densities for four mobility ranges were measured in several locations outside and inside a laboratory containing operating radar display equipment during the summer of 1970. Although the inside total ion density was low, a significant percent excess charge for very small ions was found in the vicinity of the RBDE-5 radar displays. The imbalance, in favor of positive ions, exceeded +33 percent. This positive imbalance, possibly the cause of the irritating sensations, might be due to the 20 kilovolt positive accelerating potential used for the displays. The thresholds for the onset of deleterious effects of positive ions were tentatively defined. The importance of atmospheric ionization as an environmental factor relevant to the mission of the Federal Aviation Administration was documented.

Author

N72-23490# ARO, Inc., Arnold Air Force Station, Tenn. **RESULTS OF WIND TUNNEL TESTS ON A FLIGHT PATH ACCELEROMETER AT MACH NUMBERS FROM 0.2 TO 3.0** Final Report, 7 Jun. - 18 Aug. 1971

James C. Uselton and T. O. Shadow AEDC Feb. 1972 26 p refs

(Contract F40600-72-C-0003; AF Proj. 6903; ARO Proj. VA0078)

(AD-736819; AEDC-TR-71-260; ARO-VKF-TR-71-187) Avail: NTIS CSCL 14/2

A program was conducted at the Arnold Engineering Development Center (AEDC) to design, fabricate, and test new full-scale angle-of-attack and sideslip vanes for the newly developed flight path accelerometer (FPA) to alleviate the dynamic stability problem of the previous vanes. The investigation was conducted in the von Karman Gas Dynamics Facility (VKF) Supersonic Wind Tunnel (A) and in the Propulsion Wind Tunnel Facility (PWT) Aerodynamic Wind Tunnel (4T). From dynamic stability tests of several vane configurations, the best performance vanes were selected and a position error calibration of Reynolds number range based on boom diameter from 160,000 to 1,140,000. The angle of attack ranged from -3 to 24 deg. The selected vanes were dynamically stable over the entire Mach number range.

Author (GRA)

N72-23509# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

BALLISTIC VULNERABILITY OF BORON/EPOXY DOUBLE WALL DRIVE SHAFTS Final Report, Feb. - Jun. 1971

Robert T. Welge and Frank H. Veit Fort Eustis, Va. USAAMRDL Oct. 1971 45 p refs

(Contract DAAJ02-71-C-0021)

(AD-737285; USAAMRDL-TR-71-50) Avail: NTIS CSCL 13/9

Seven boron/epoxy double-wall shafts were ballistically impacted while under torque loads ranging from 7,500 to 12,300 in.-lb. Projectile velocities ranged from 1,540 to 2,500 fps. Static residual strength tests were then conducted. Three aluminum shafts were tested similarly for comparison. The residual strength of the boron/epoxy shafts was approximately 8,000 in.-lb, which is about one-third the ultimate strength of an undamaged tube. The aluminum shafts exhibited residual strengths of 22,000 to 32,000 in.-lb, which would be sufficient to carry expected flight loads.

Author (GRA)

N72-23655# Department of Transportation, Washington, D.C. Library Services Div.

AIRCRAFT AND AIR POLLUTION, SELECTED READINGS Report for 1960 - 1971

Dorothy J. Poehlman Dec. 1971 68 p

(AD-735943; Bibliographic-List-7) Avail: NTIS CSCL 13/2

Presented is a selected, partially annotated listing of papers, reports, and periodical articles, on the subject of environmental

pollution caused by aircraft emissions. Noise pollution is not included. The period covered is from approximately 1960 - Spring 1971. The arrangement is by subject categories with author, corporate source and geographic indexes. Author (GRA)

N72-23660 Ohio Univ., Athens.
OPTIMUM ADAPTIVE PHASE ESTIMATION RECEIVER FOR ONE-WAY RANGING AIRCRAFT NAVIGATION Ph.D. Thesis

Patrick Henry Garrett, II 1970 176 p
 Avail: Univ. Microfilms Order No. 71-16486

One-way ranging was used to measure the phase delay of a transmitted electromagnetic wave measured at an aircraft as a function of the intervening station-to-aircraft distance. Two or more stations are required to obtain position fixes. Principles of statistical communication theory were used to provide the basis for an adaptive maximum likelihood phase estimation receiver, formulated in terms of Bayes' rule to permit the inclusion of a priori information about the phase efficiently in the receiver structure. A Marko process aircraft position prediction model was derived and mechanized to provide information based on prior signal measurements. Theoretical studies and comparisons with other receiver structures, such as conventional phase-locked loops, independent verification by digital and hybrid computer simulation methods, and flight experiments with actual hardware prototype receivers provided conclusive results. Dissert. Abstr.

N72-23663 Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris.

DOPPLER SYSTEM GRANULARITY
 P. Fombonne Jul. 1970 17 p
 (AT/DTRN/2174) Avail: Issuing Activity

Theoretical analysis of a proposed method to reduce the granularity in a Doppler system signal spectrum using direct frequency counting is reported. The method involves phase shifts from one scan to the next in order to reduce the granularity of the angular information transmitted by a network of switched sources. It is concluded that the signal must be filtered through a $2/T$ bandwidth in order to preserve its main features, T being the scan duration. It is shown that the proposed phase shifting technique lowers the granularity inherent in direct frequency counting. Author (ESRO)

N72-23664* Drexel Univ., Philadelphia, Pa.
DEVELOPMENT OF VISUAL-DISPLAY AID TO AIR NAVIGATION Annual Report, 1 Jan. - 31 Dec. 1971

T. J. Matcovich Feb. 1972 101 p refs
 (Grants NGR-39-004-038; NSF GK-17861)
 (NASA-CR-112062) Avail: NTIS HC \$7.25 CSCL 17G

The design, development, and fabrication of a visual display aid to air navigation are discussed. The display will locate an aircraft on a standard navigational chart when activated by two independent directional signals. The display consists of a radial pattern of electrically conductive line pairs, liquid crystal material contained between the line pairs, and addressing and activating electronics. The application of a voltage to the addressed line pair will cause the liquid crystal to become white in color, thus indicating the direction to the selected VOR station. Author

N72-23668# Mitre Corp., McLean, Va.
COST ANALYSIS OF THE MICROWAVE LANDING SYSTEM PROGRAM Final Report

Thomas L. Croswell Dec. 1971 110 p refs
 (Contract DOT-FA70WA-2448)
 (AD-737036; MTR-6068; FAA-EM-71-1) Avail: NTIS CSCL 17/7

The report describes a cost study performed for the new replacement all weather instrument landing system. Costs are determined for two Scenarios: (A) following the National Plan for Microwave Landing Systems, and (B) those currently operational systems (GCA - ILS ...) expected to exist in the absence of the national MLS. For civil ground systems, Scenario A (MLS) produces a significant cost saving; resulting principally from the elimination of restrictive site requirements and reduced frequency of flight inspections. Military ground systems also favor MLS due to earlier retirement of GCA systems. Both of these cost savings are offset by the extra cost of airborne MLS, especially to the more than 700,000 general aviation aircraft projected for the year 2000. Over a 30-year period, the total costs to the nation under the MLS plan are not significantly higher than costs of continuing with current systems. The conclusion is that the lack of a cost penalty, combined with the performance, safety, and economic benefits, make a solid case for MLS. Author (GRA)

N72-23669# Transportation Systems Center, Cambridge, Mass.
AN INVESTIGATION OF MICROWAVE LANDING GUIDANCE SYSTEM SIGNAL REQUIREMENTS FOR CONVENTIONALLY EQUIPPED CIVILIAN AIRCRAFT

Maurice H. Lanman, III Jun. 1971 186 p refs
 (AD-737339; DOT-TSC-FAA-71-24; FAA-RD-71-86) Avail: NTIS CSCL 17/7

The report describes efforts leading to the determination of minimum suitable scan rates for the azimuth and elevation functions of the microwave Landing Guidance System (LGS) proposed by RTCA SC-117, based on performance requirements of two conventionally equipped civilian aircraft. Two complementary methods are used; one involving a full nonlinear digital simulation, the other involving direct covariance matrix propagation. Wind and turbulence models, aircraft models and LGS models are described in detail. Author (GRA)

N72-23671# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INTERROGATION SCHEDULING FOR THE DISCRETE ADDRESS BEACON SYSTEM

E. J. Kelly 24 Jan. 1972 59 p refs
 (Contracts F19628-70-C-0230; DOT-FA72WAI-242; FAA Proj. 034-241-021)
 (AD-737294; ATC-8; FAA-RD-72-7) Avail: NTIS CSCL 17/7

The report is an attempt to define the interrogation scheduling problem which arises in the implementation of the discrete address beacon idea. The interfaces of this problem with other parts of the beacon system design are discussed, and several specific algorithms for scheduling are analyzed for both arrays and rotating antennas. GRA

N72-23805# Monsanto Research Corp., Dayton, Ohio.
ENVIRONMENTAL DEGRADATION OF FUELS, FLUIDS, AND RELATED MATERIALS Technical Report, 1 Feb. 1969 - 30 Nov. 1971

William G. Scribner Jan. 1972 103 p refs
 (Contract F33615-69-C-1325; AF Proj. 3048)
 (AD-736839; MRC-DA-310; AFAPL-TR-71-101) Avail: NTIS

Research on hydrocarbon fuel properties (principally JP-7), fuel additives, and organic and inorganic contaminants in fuels is described. Analytical methods developed are presented in detail, and include a specific ion electrode method for PWA-536 in JP-7, gas chromatographic methods to 'fingerprint' JP-7 and to detect volatile contaminants, a column chromatographic-infrared spectrophotometric method to isolate and identify polar contaminants in JP-7, and atomic absorption spectrophotometric methods for metal naphthenates in fuels at the parts per billion level. Measurements of JP-7 heat of combustion, electrical, and other physical properties are tabulated. Bench and field studies of the depletion of fuel system icing inhibitor from JP-7 are presented. Detailed studies of a polyurethane foam degradation problem and the evaluation of a small scale test to measure thermal stability are summarized. Author (GRA)

N72-23836* General Dynamics Corp., San Diego, Calif.
STATIC PERFORMANCE OF A 13.97 CM (5.5 INCH) DIAMETER MODEL VTOL LIFT FAN
 W. H. Lowe and R. W. Sanger Washington NASA May 1972 33 p
 (Contract NAS3-15563)
 (NASA-CR-2051; HST-TR-329-O-1) Avail: NTIS HC \$3.00 CSCL 21E

A tip-turbine-driven fan of the type currently being used in wind tunnel tests of VTOL lift fan models was tested. Values of thrust, weight flow, exit total and static pressure, exit swirl angle, and turbine temperature drop were measured as a function of fan speed for several inlet and exit configurations. A standard fan performance map was also obtained. Author

N72-23837* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMICS OF A SUPERSONIC INLET-ENGINE COMBINATION SUBJECTED TO DISTURBANCES IN FUEL FLOW AND INLET OVERBOARD BYPASS AIRFLOW
 Robert E. Wallhagen, Francis J. Paulovich, and Lucille C. Geyser Washington May 1972 46 p refs
 (NASA-TM-X-2558; E-6115) Avail: NTIS HC \$3.00 CSCL 21E

An axisymmetric mixed-compression supersonic inlet and a single-spool turbojet engine were dynamically tested at Mach 2.5. The propulsion system was subjected to sweep-frequency sinusoidal disturbances of either inlet overboard bypass airflow. The disturbances were at a logarithmic sweep rate of 1 decade per minute. Dynamic responses were taken of signals throughout the propulsion system. Selected signals were reduced relative to the prime propulsion system parameters. The experimental data are presented in Bode plots. Most of the plots are for a frequency range of 1.0 to 50 hertz. Author

N72-23838* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY EXPERIMENTS ON THE NOISE GENERATED BY TARGET-TYPE THRUST REVERSER MODELS
 Orlando A. Gutierrez and James R. Stone Washington May 1972 61 p refs
 (NASA-TM-X-2553; E-6707) Avail: NTIS HC \$3.00 CSCL 21E

Experiments are reported on the noise generated by model V-gutter and semicylindrical target-type reversers with circular nozzles. Nozzles were 5.24 and 7.78 cm in diameter. Nozzle pressure ratio ranged from 1.25 to 1.72. The spacing between reversers and nozzle, as well as the reverser orientation, was also varied. More noise was generated with reversers than with the nozzle alone. The measured maximum overall sound pressure level varied with the sixth power of the nozzle exit velocity. Noise levels were more uniform in regard to directivity with reversers than with the nozzle alone. It is concluded that thrust reversers, can be a significant noise problem, especially for STOL aircraft using thrust reversers during approach. Author

N72-23847* Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
DESIGN OF MAXIMUM THRUST NOZZLES WITH NONEQUILIBRIUM, CHEMICALLY REACTING FLOW. VOLUME 1: THEORETICAL DEVELOPMENT AND RESULTS
 Final Technical Report, 1 Jan. 1969 - 31 Aug. 1971
 Allan A. Taylor and Joe D. Hoffman Wright-Patterson AFB, Ohio AFAPL Dec. 1971 64 p refs
 (Contract F33615-67-C-1068; AF Proj. 3012)

(AD-737378; AFAPL-TR-71-92-Vol-1) Avail: NTIS CSCL 21/5
 An analysis is presented which permits the design of maximum thrust nozzles for nonequilibrium chemically reacting gas flows. The analysis is based upon the governing equations for a general, multi-component reacting gas. The effects of viscosity, multiple phases, body forces and mixing are neglected. All other states of the gas are assumed to be in equilibrium. Design of the nozzle contour is posed subject to a general isoperimetric constraint. The thrust to be maximized is written in terms of an integral of the pressure forces on the nozzle wall.

The design constraints and governing equations are incorporated into the integral to be maximized by means of Lagrange multipliers. Author (GRA)

N72-23936* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RATE OF FATIGUE CRACK PROPAGATION IN THE AIRFRAME STRUCTURE
 Witold Blazewicz 18 Nov. 1971 15 p refs Transl. into ENGLISH from Tech. Lotnicza i Astronautyczna (Poland), v. 25, no. 2, 1970 p 10-13, 20
 (AD-736887; FTD-HC-23-1487-71) Avail: NTIS CSCL 01/3

A description is given of a method for calculating the fatigue strength of airframe structures with an existing crack. The method makes it possible to determine the dependence of crack length on the duration of usage (number of kilometers covered in flight or the number of flight hours). The technique was used to study fatigue strength in samples with and without strain hardening, showing the influence of strain hardening on crack propagation parameters during variable amplitude loading (based on load spectra for transport aircraft). The test data show the possibility of a significant reduction on the rate of crack propagation with the aid of properly chosen strain hardening. Author (GRA)

N72-23966* Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.
IGNITION AND FIRE SUPPRESSION IN AEROSPACE VEHICLES Technical Report, 1 Jan. 1970 - 30 Nov. 1971
 Joseph M. Kuchta, Ralph J. Cato, George H. Martindill, and Irving Spolan Wright-Patterson AFB, Ohio AFAPL Dec. 1971 49 p refs
 (Contract F33615-69-M-5002; AF Proj. 3048)
 (AD-737383; PMSRC-4164; AFAPL-TR-71-93) Avail: NTIS CSCL 13/12

Several halogenated hydrocarbons were evaluated as possible ignition or explosion suppressants for aircraft fuel tanks in which ignitions are initiated by incendiary ammunition. The inhibitors included Halons 2402 (C2F4Br2), 1301 (CF3Br), 1202 (CF2Br2), 1211 (CF2ClBr), and 1011 (CH2ClBr). Their effectiveness in retarding ignition or propagation of n-pentane-air mixtures was investigated with heated wires, exploding wires, and an incendiary composition. Large-scale experiments were conducted with Halon 1301 to determine its effectiveness and toxicity hazard in extinguishing Class A fires by the total flooding mode. A 6 percent Halon concentration was adequate for rapid extinguishment of cotton sheeting, paper sheeting, and nylon-paper sheeting fires. The toxic product formation varied with preburn time, combustible loading, and the extinguisher discharge mode. In addition, similar data are presented from small-scale experiments with Halon 38 (C3F8), which is less effective than Halon 1301 as an extinguishant. Author (GRA)

N72-23974* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VEHICLE TECHNOLOGY FOR CIVIL AVIATION: THE SEVENTIES AND BEYOND Supplement: Panel Discussion
 Washington 1972 25 p Conf. held at Langley Sta., Va., 2-4 Nov. 1971
 (NASA-SP-292-Suppl) Avail: NTIS HC \$3.00 CSCL 01E

The panel discussion on aviation technology for the seventies and beyond is reported. Topics discussed include: Government role in developing and applying new aeronautical technologies, noise and environmental problems, and congestion in the vicinity of major air terminals. F.O.S.

N72-23979* RAND Corp., Santa Monica, Calif.
THE EFFECT OF FUEL PRICE INCREASES ON ENERGY INTENSIVENESS OF FREIGHT TRANSPORT
 W. E. Mooz Dec. 1971 55 p refs

(Grant NSF GS-31253)

(R-804-NSF) Avail: NTIS HC \$4.75

The use of energy for transporting U.S. intercity freight and the effect of higher fuel price are analyzed. Methods of estimating unit energy consumption are developed and applied to determine average values and trends. Water transport is found to consume an average 500 BTU per ton/mile, rail 750, pipeline 1850, truck 2400, and air cargo 63,000, or 45 times the average for all transport modes in 1968. Only a small shift to air freight, from the present less than 0.2% to 2% of all intercity ton/miles, would double the average unit energy consumption for all freight modes. If present trends continue, this increase will occur by the year 1996. Because of its high fuel consumption, however, air freight growth would tend to be inhibited by higher fuel prices, while surface transport would be little affected. Higher fuel prices may result from shortages, the cost of environmental constraints, new taxes, or other reasons. Author

thermostructural response of reentry nose tips, noise levels in aircraft, nematic liquid crystals, airborne fuze function indicators, short range attack missile (SRAM) navigation system, nonflammable fibrous materials, organophosphorus insecticide decontaminant, radar cloud/target polarization discrimination, shear-induced atmospheric turbulence, X-T Plotter for igloo white, military communications satellites, infrared image converters, the conus autovon, infrared imagery in environmental change, and effective maintenance data. GRA

N72-23980# Federal Aviation Administration, Washington, D.C. Office of Systems Engineering Management.

ENGINEERING AND DEVELOPMENT PROGRAM: GOALS, ACHIEVEMENTS, TRENDS

31 Mar. 1972 179 p

Avail: NTIS HC \$11.00

Engineering and development progress achieved during 1 April 1971 to 31 March 1972 is reported for FAA top management, DOT, FAA Services, Offices, Regions, Centers, and the aviation community. The emphasis is on the system, terminal tower control, runways/taxiways, aircraft safety, and support programs. Beacon, navigation, landing system, weather studies are described, and the radar, communication, oceanic, flow control, enroute control, flight service station, technology, satellite, environmental protection, and pilot warning indicator/collision avoidance system programs are also covered. N.E.N.

N72-23983# Air Force Systems Command, Washington, D.C.

PROCEEDINGS OF THE AIR FORCE SYSTEMS COMMAND 1971 SCIENCE AND ENGINEERING SYMPOSIUM, VOLUME 1 Final Report

Arthur G. Wimer, Jr., (comp.) Dec. 1971 625 p refs Conf. held at Dayton, Ohio, 5-7 Oct. 1971 2 Vol.

(AD-736127; AFSC-TR-72-002-Vol-1) Avail: NTIS CSCL 14/2

The report is a compilation of papers presented at the Air Force Systems Command 1971 Science and Engineering Symposium held October 1971. The papers discuss topics including air pollution control, gas chromatography, laser guidance, real time telemetry, radar elevation bias, doppler tracking receivers, hologram interferometry, electro-optical seeker systems, electromagnetic acceleration of gas, completely integrated reference instrumentation system (CIRIS), radiative modelling of the atmosphere, lightweight high energy battery, airdrop from cargo aircraft, intercell planar heat pipe, airfield foundations, vaporization of oxide scales, radiation effects in silicon semiconductors, interfacing problems on CCV performance. GRA

N72-23984# Air Force Systems Command, Washington, D.C.

PROCEEDINGS OF THE AIR FORCE SYSTEMS COMMAND 1971 SCIENCE AND ENGINEERING SYMPOSIUM, VOLUME 2 Final Report

Arthur G. Wimer, Jr., (Comp.) Dec. 1971 730 p refs Conf. held at Dayton, Ohio, 5-7 Oct. 1971 2 Vol.

(AD-736128; AFSC-TR-72-002-Vol-2) Avail: NTIS CSCL 14/2

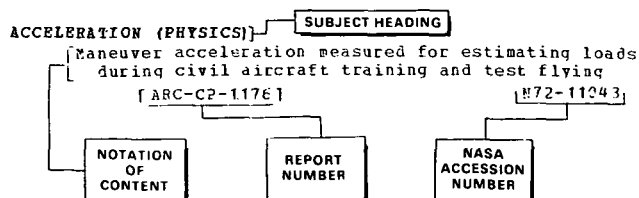
The report is a compilation of papers presented at the Air Force Systems Command 1971 Science and Engineering Symposium held October 1971. The papers discuss topics including GETT simulation, video data reduction, mechanical impedance technique, high current pulse testing of microcircuits, holographic interferometry, crack propagation tests in the F-111, gyroscope centrifuge test, biodynamic model on spinal injuries from ejection seats, metal vapor lasers, discharge in gas lasers,

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AERONAUTICAL ENGINEERING / *A Special Bibliography (Suppl. 21)*

AUGUST 1972

Typical Subject Index Listing



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Numerical analysis of flight loads by additional extreme value analysis and measurement of vertical accelerations on transport aircraft
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Acoustic measurements for STOL turboprop transport aircraft propeller configurations under static, taxi and flyover conditions, discussing quiet propeller noise signature

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Tu-104 turboprop aircraft flight noise measurements and spectral changes at different distances from landing strip, evaluating public nuisance and resident reactions

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Maximum overpressures of supersonic aircraft maneuvering-produced sonic booms occurring at geometrical acoustic ray focus points /caustic cusps/

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Digital data processing techniques for aircraft engine noise data reduction, analyzing fan noise spectrum

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Acoustic measurements to determine aerodynamic noise characteristics of single stage fan with 1.5 pressure ratio and 1160 feet per second tip speed [NASA-CR-120789]

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Future projections of commercial jet aircraft fuel demands, estimating engine exhaust effects on air quality
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Annotated bibliography on environmental pollution caused by aircraft emissions
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Electrical analog simulation of internal combustion engines intake and exhaust systems nonstationary gas flow, considering cylinder, turbine and supercharger operation
A72-29136

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Large amplitude flight simulator for fighter design refinement, noting extensive computer commitment
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Wind tunnel measurements of aerodynamic damping and oscillatory stability in pitch and yaw for scale model of carrier based variable-sweep fighter aircraft with twin vertical tails
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Book of aircraft design illustrations covering three view and perspective form low drag airfoil, aspect ratio, plain split, slotted and multiple flaps
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French monograph on velocity profile in laminar boundary layer on semiinfinite flat plate in harmonic oscillation of uniform incompressible flow
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Airborne OMEGA navigation system performance, discussing transmission facilities, three frequency receiver, flight tests and optimization of receiving antenna

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Preproduction OMEGA aircraft receivers and antennas development and flight testing, noting signal loss problems in high noise or precipitation static environments

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OMEGA receiver integration into Navy P-3C airborne computerized navigation system, describing flight test, maintainability and laboratory simulation programs

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Test flights into weather at midlatitudes and tropical systems with airborne OMEGA navigation system, discussing E field and H field antennas

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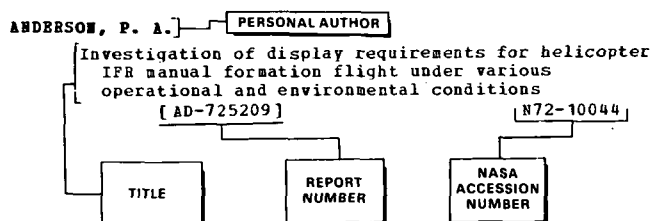
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